1. Operational information and some general remarks

- **What will you learn?** This is a subject for students majoring in language studies. Its modest aim is to introduce the basic concepts and diluted theories concerning the study of meaning and use, i.e. semantics and pragmatics. The rudiments of both the areas will be covered, with semantics and pragmatics sandwiching a little bit of natural language logic, which is considered indispensable for understanding the main content of S & P. Its more ambitious aim is to acquaint students with an in-depth understanding of our knowledge of meaning and use of language that involve semantics, pragmatics, discourse analysis, rhetoric, semiotics and communication studies. The delivery of the subject will thus take two steps:
  - **Step 1:** Acquiring a working knowledge of basic concepts
  - **Step 2:** Getting to know some important theories/approaches

- **Type of knowledge delivered:** On the theoretical side, we will learn to appreciate the significance of inventing and working with a set of special concepts concerning meaning. We will also learn the rationale behind some important theories of meaning and use. Using these concepts and theories, we will learn how to analyze data in English and Chinese. An extension to such a study will be to try to discover and collect new data, guided by the concepts and theories, analyze the data, and write reports on them. In these ways, we hope to strike some balance between the theoretical and the applied/practical aspects of inquiry.

- **Technical Emphases:**
  - Getting to know the key concepts and their exemplifications in English and Chinese
  - Grasping the general method of meaning representation (patterns) ⇒ local logical representations and computation
  - Critically evaluating the proposed mechanisms of meaning inference (in context) ⇒ hybrid logical inferences and the theory of mind

- **What will this subject make you?** It will enable you to build on your specialized knowledge on the working of language, not so much from the structural aspects but on the side of meaning composition, meaning transfer, and meaning comprehension. It will enable you to conduct expert analysis on the logic and meaning of given sentences and utterances, either as individual uses or taken from public/published works. It will give you training in critical thinking because meaning IS an important aspect of critical thinking, if not THE most important.

- **Seeking Clinical Applications (beyond the subject content)** Frequent references will be made to clinical pragmatics and clinical discourse analysis so as to enable students to see the relevance of general semantic and pragmatic discussions, even though it is not possible for us to address clinical issues directly, due to the constraint of time. We will also emphasize the importance of corpus construction and field work in doing pragmatic analysis.

- **How to use the study materials?** Lecture notes will be distributed in the form of e-copies on a weekly basis and will serve as detailed outlines of lecture content. Reading chapters and excerpts taken from textbooks are also mounted on the BLACKBOARD. You are expected to read both the lecture notes and the assigned readings. Further questions for thinking and for discussion will be posted and will be discussed in class.

2. Assessment

Two tests (one on semantics [Oct.], the other, on pragmatics/ discourse and rhetoric [End of the term])
One short essay (applied in nature) on one aspect of meaning studies will need to be completed by the end of the semester (around 1500 words).

3. Getting help when in need

- email: yan.jiang@polyu.edu.hk
- Check updates at BLACKBOARD
- Email me for a meeting at office AG505 or through Skype: ctyjiang
4. **Textbooks**

**Main**
- Paul H. Portner: What is Meaning.
- Thomas R. Hofmann: Realms of Meaning.
- Kate Kearns: Semantics, 2nd edition.
- Peter Grundy: Doing Pragmatics, 3rd edition.

**Supplemented by selected sections from other textbooks, papers in handbooks and collections, esp.**
- The Handbook of Pragmatics online Editors: Jan-Ola Östman & Jef Verschueren Accessible via PolyU Library Web-Site [recommended for frequent consultation]
- + A reference list of clinical linguistics (in preparation)

**Easier works (for self-paced crash studies):**

5. **Drawing the boundaries**

**What is semantics?**

Short definition: Semantics is the study of word meaning and literal sentential meaning. By “literal sentential meaning”, we mean “the basic meaning”, i.e. meaning composed out of the dictionary meaning of words contained in a sentence.

Examples (What is the literal meaning? What is the non-literal meaning?):

1. Two plus two is four.
2. Student A: Are you going to Professor X’s lecture this afternoon? I know he is famous and I have never seen him before.
   
   Teacher B: I need to be paid to go to his lecture!
3. You are the cream in my coffee.
4. Parent: Make sure you do all the assignments.
   
   Child: I know what I am doing.
5. Newspaper: The xxx government, out of its great wisdom, has decided to build yet another international airport, a decision that has astounded the public for the huge expenses incurred.
6. Student A: When I read about World War I, I was surprised at the figures of casualty.
   
   Student B: War is war.

   o Approaches: Linguistic semantics, formal semantics, cognitive semantics, computational semantics
   o Divisions: lexical semantics, compositional semantics (sentence semantics)
   o Combinations: compositional + formal, lexical + descriptive, lexical + computational, lexical + cognitive, lexical + formal

**What is pragmatics?**

Short definition: Pragmatics is the study of meaning change, meaning extension and meaning recovery in context.

Which sentences in examples 1-6 involve meaning change? Which involve meaning extension?
What do we mean by meaning recovery? Speaker produces sentences. Sentences may be incomplete in meaning, ambiguous, vague, and indirect. Hearer receives sentences and recovers the intended messages.

Theories: speech act theory, Gricean theory, relevance theory, neo-Gricean theory. Since pragmatic theories try to explain why we can comprehend variable meanings in context and how, they also give partial accounts of “theory of mind” [讀心術、心理理論], which can prove to be very useful even in daily life. [check out the Wikipedia entry on “theory of mind”].

- Phenomena: deixis, presupposition, implicature, explication, propositional attitudes [including speech acts]
- Approaches: Linguistic pragmatics, cognitive pragmatics, macropragmatics, formal pragmatics
- Theories: speech act theory, Gricean theory, relevance theory, neo-Gricean theory

What is discourse analysis?
Short and inadequate definition: the study of discourse structures and patterns
Approaches: discourse grammar, conversation analysis
Broader studies: critical discourse analysis (CDA), Clinical discourse analysis (CDA2?)

What is rhetoric?
Short definition: the study (analysis and appreciation) of the conscious means and strategies of persuasion, language embellishment, discourse planning, and language use in social contexts
Divisions: Plain Rhetoric, Creative Rhetoric, Cognitive Rhetoric, Literary Rhetoric (Literary Stylistics), Rhetoric Criticism
Phenomena: figures of speech (numerous), tropes (meaning transfer), the more plain ones, + the more fancy ones (what the cognitive linguists have been creating: mapping, blending, semantic leaps, root metaphor, etc.)

6. A First Map of Meaning, to be instantiated in more detail as we move on

The variety of word meaning forms the semantic network of a language. Word meanings combine to yield sentence meaning (literal meaning). Literal meaning is twisted, enriched and extended to produce non-literal meaning or indirect meaning, which is considered to be pragmatic meaning (sometimes also called rhetorical uses [very often overlapping with pragmatics: depending on how they are defined and differentiated]).

When meaning is studied in context, it becomes the common object of study for semantics, pragmatics, discourse analysis and rhetoric.

7. What is the meaning of meaning?

What is meaning? That is a question that needs to be addressed. Answers to this question will determine the way we study meaning. Let us look at some examples, which show us how we use the words “mean” and “meaning” in ordinary language.

(1) ... I mean... I mean. 〔為避免話語停頓所採用的插入語(place-filler)〕
(2) What is the meaning of life? 〔重要性〕significance
(3) I did not mean to hurt you. 〔打算〕intend
(4) What is the meaning of ‘computer’? 〔定義〕definition
(5) He never says what he means. 〔想要表達的內容〕wishes to convey
(6) She rarely means what she says. 〔付諸行動〕put into action
(7) He means well, but he is rather clumsy. 〔意願〕intends
(8) Fame and riches mean nothing to the true scholar. 〔有／無價值〕have the value of
(9) Dark clouds mean rain. 〔預示〕foretells
(10) It was John I meant, not Harry. 〔指稱，意指〕refer to
(11) The Latin word 'rosa' means 'rose'. 〔等同於〕is equivalent to

Think about Chinese cases. Do we have more or less the same picture?

Cf. the following examples:

[1] 你沒聽懂我的意思。nǐ méi tīng dǒng wǒ de yì sī [You don’t see what I meant.]
[2] “讀心術”這個詞兒是什麼意思？“dú xīn shù ”zhè gè cí ér shì shí me yì sī [What is the meaning of “theory of mind”?]
[3] 我看不明白這句話的意思 wǒ kàn méi máng bái zhè jù huà de yì sī [I did not get the meaning of this sentence]
[4] 不懂你想表示什麼意思。bú dǒng nǐ xiǎng biǎo shì shí me yì sī [Don’t know what you wanted to express]
[5] 你這是什麼意思？nǐ zhè shì shí me yì sī [What do you want?]
[6] 你們領導可真有意思 nǐ men lǐng dǎo kě zhēn yǒu yì sī [Your boss is kind of interesting.]
[7] 中秋節快到了，給老師買盒月餅意思意思。zhōng qiū jiē kuài dào le ，gěi lǎo shī mǎi hé yuè bǐng yì sī yì sī [The Mid-Autumn festival is coming. You should buy a box of moon-cakes for your teacher as a token of courtesy.]
[8] 這篇文章沒什麼意思 zhè piān wén méi shí me yì sī [This paper is rather boring/vapid.]
[9] 這種說法有點意思 zhè zhòng shuō fǎ yǒu diǎn yì sī [This saying has something to recommend itself.]
[10] 他沒意思 zhè méi yì sī [This man is a jerk.]
[12] 你懂我的意思嗎？nǐ dǒng wǒ de yì sī ma [You see what I mean?]
[13] 不做不夠意思，做點意思意思，做好了沒啥意思，做多了你啥意思？bú zuò bú gòu yì sī，zuò diǎn yì sī yì sī，zuò hǎo le méi shá yì sī，zuò duō le nǐ shá yì sī？ [Uttered by a deputy: Doing nothing is not being friendly; Doing a little as a token of good will. Doing well is not rewarding; Doing too much makes you questionable.]
[14] Use of 意義
[15] Any others?

What can be concluded from the above observations? Answer: Natural language is incorrigible. (but why?)

8. **Word and object: referential meaning**

Language users can use language to talk about the world. They can use words and phrases to refer to objects and places, to people, to ideas and feelings, etc. They can also use sentences to refer to events and states. This relationship is called “reference”. The related verb is “refer”. Thus words and sentences can have “referential meaning”. 指稱，指稱義

-- Names [also called proper nouns] are rigid designators: allowing no referential variations. Julius Caesar, Chris Patten, Julia Roberts

-- 【 the + N 】 refers to a definite individual (person or thing): the building, the book, the teacher, but each use can refer to a different individual

-- 【 a + N 】 refers to at least one indefinite individual: a book, a passenger, a dog, a cup, and each use can refer to a different individual

-- Common nouns refer to sets of individuals: student, teacher
-- pronouns are variables whose values remain to be instantiated
Modification: it is not the words per se that refer. Rather, it is the meaning in words that does.
Likewise, it is not the sentences per se that refer to events and states 事件與狀態. It is the propositions in sentences that are used to refer.
Examples:

[1] A trough of low pressure continues to affect the coastal areas of Guangdong. Locally, it was rainy this morning. More than 30 millimetres of rainfall were recorded in many places, and rainfall exceeding 100 millimetres were recorded over the eastern part of Hong Kong Island and the central part of Kowloon. Besides, the ridge of high pressure over southeastern China is bringing an easterly airstream to eastern Guangdong.

[2] Samsung Electronics and Qualcomm unveiled smartwatches on Wednesday, tapping a potential “wearables” market worth an estimated US$50 billion as the high-end mobile phone market becomes saturated.

What is a “proposition” 命題?
Proposition in meaning studies means a statement 陳述 or assertion 斷言, often carried in a declarative sentence. It can be evaluated as being either true or false. So it has truth-values 真值. Some other sentences do not carry propositions because their meaning is not truth evaluable, e.g. orders, questions, exclamations. We can take propositions to be the meaning of declarative sentences 陳述句.
Sentences are language-dependent, but propositions are language independent. On the other hand, a proposition can only be expressed by a sentence of a specific language.
Since propositions refer to situations and states, which are either true or false, the reference of propositions can be taken as truth-values, or simply truth. This notion of “truth” 真 is to be understood in a plain sense. It does not mean “always right” 真理. It only means “having the quality of being compatible with the real-world situation or not”.

Conclusion: What is meaning? Meaning is reference. At the sentence level: Meaning is truth.

Reading Assignments:
First, read Howard Gregory: Semantics, Chapter 1, Pinning down meaning. Do the exercises.
Then read Kearns, Chapter 1 (1.1-1.3). Do the relevant exercises.
If you want to read more, try Hurford et al. Semantics: A Coursebook, Units 1-3. [easier than Kearns]
Read also Leech, Chapter 1 & 2, Portner, Chapter 1
Everyone can use language well, if he is rational. Likewise, everyone can convey and comprehend meaning well, and in such an effortless way. Equipped with this semantic competence, one hardly needs to learn about it to be able to render good performance in meaning communication. Yet, what is common needs to be scrutinized sometimes, if only as academic inquiries. When you observe some such deficiencies in clinical practices, for example, you will want to have a good knowledge of meaning studies: how we should categorize meaning, how children acquire various types of meaning, and at what periods of development? As another example, when you do translation studies, you may realize that your understanding of meaning is insufficient. There are varied types of meanings, each requiring different strategy in translation. Which type of meaning in the source is matched by which equivalent kind in the target language. That is a pertinent question to ponder on. Otherwise, it will be hard to measure faithfulness, expressiveness and elegance. Lots of examples are provided in Leech (chapter 1) to show that we have semantic intuitions, which can distinguish between meaningful examples and anomalous ones. But when Leech talks about treating meaning within the room as a self-contained system, without the need of going outside, his view is no longer held to be acceptable. Leech (chapter 2) also distinguishes seven types of meaning and emphasized the importance of studying conceptual meaning. He also identifies two important features of conceptual meaning: contrastiveness and being structured. The latter can be related to the notion of meaning composition in formal semantics.

1. From Reference to Denotation

Having established that words refer to external individuals, let us study some examples.

(1) Barack Obama is the president of the United States.
(2) I have seen President of the United States face to face.
(3) The president of the United States lives in the Whitehouse. [The White House is the official residence and principal workplace of the President of the United States, located at 1600 Pennsylvania Avenue NW in Washington, D.C.]
(4) Miss America is getting taller every year.
(5) I know who David Copperfield is.

For proper nouns, i.e. names, the mere mention of a name will necessarily refer to a unique individual, unless there happens to be namesakes. If one-name-one-individual is involved, then a name’s reference can be identified without accessing contextual information, and without knowing the participants of the discourse, i.e. the speaker, the hearer, etc. That is why names are called rigid designators or unique identifiers. For other nouns and noun phrases, their referents vary, depending on the use, involving the user and the occasions of use. So taken out of context, it is hard to say what “this book” refers to. A book, but which one?

Although it is hard to say which exact book “this book” refers to, it should refer to a particular book for sure. So it will not do to use “this book” to refer to a snail on the wall, unless you are using the expression in some metaphorical way. That means “this book”, by its semantic nature, does not have the potential to refer to a snail. “This book” has the referential potential of being related to a particular published reader, but not a particular snail. The latter is referred to by “this snail”. So words and expressions not only refer to actual things, but they also have the referential potentials of being able to refer. We take this property of words as having the referential potential “denoting”. Hence the verb “denote”, and the noun “denotation”, as well as the adjective “denotational”.

“a” refers to “b” def. = “a” the language symbol is used by speaker S to point to “b” the actual external individual.
“c” denotes “d” def. = “c” has the referential potential to be linked to “d” which is a notional individual.

Now we should also revise our previous assertion about sentence meaning. Taken in a notational sense, sentences denote states of affairs, which are truth-evaluable. Therefore, sentences denote truth-values. On the other hand, the actual use of a sentence still refers to an actual event or state. And it refers to the value true (T or 1) or to the value false (F or 0).

Exercise:
[1] How should we understand such a proposition: Words denote, and they refer?
[2] Tell the difference between the denotation of “a red rose” and its reference.
[3] What is the denotation of a name? And what is its reference?

2. Verbs and denotation

What do verbs denote? Intransitive verbs characterize properties such as “sleep”, “smile”, “dance”, “faint”. Such properties do not exist by themselves but are parasitic on individuals. Hence properties are in fact sets of individuals. “sleep” denotes a set of individuals that have the property of sleeping, i.e. sleepers; “dance” denotes the set of dancers, and “smile”, those who smile, as shown below:

Sleep: {a, f, m, s, ...}
Transitive verbs characterize relations. “John loves Mary” is a loving relation between John and Mary. Hence “love”
denotes a set of relations, each of which is a pair, like the following:

Love: {<a, b>, <c, d>, <a, d>, <f, m>, …}

{ } means “set”, i.e. a list of discrete objects. A class of students is a set. A football team is a set. An army of terms is a
set. But not a bottle of water.

< > means “ordered list”. Why do we need it for characterizing transitive verbs?

How do we characterize di-transitive verbs?

How do we characterize “is-a” meaning? (Fido is a dog. Henry James is an American. Noam Chomsky is an American linguist.)

How do we characterize “is + adjective”? (Homer Simpson is funny. The cover is blue.)

Generalizing a step further, what do predicates denote? They denote sets (of individuals or relations).

[What is a predicate?]

3. Can predicates refer in addition to denoting?

This point is usually not mentioned in textbooks. I tend to think that language users, as individuals, can only use predicates to denote. Speakers, when using nouns and noun phrases, can choose to refer to this and that individual(s). But they cannot choose or change what is denoted by a predicate, which is a list of members of the property or relation. The membership is not determined by the individual user, but is determined by time. As users cannot change the membership (which is just given by the World at a time), here no reference is involved. There is only denotation. Or it makes no sense to talk about reference. [This is how I take it. If you find some difference explanations, please let me know.]

4. Can we refer to extinct things, and things non-existent?

We can. For dinosaurs and mammoths that are extinct, we can certainly refer to them, just like we can refer to people who have passed away, and those who are yet to be born. For things like perpetual motion machine or the square round, they can also have reference. But we need a theory to support such things. To put it in the simplest way, we can say that these notions do not have existence in this world, our actual world. But they have counterparts in some possible worlds that have more physical existence. In those possible worlds, the physical laws can be different, so perpetual motion is possible. It follows that for those things that exist in the actual world, they can still have counterparts in some other possible worlds (our world, the actual world, is no more than one of the countless possible worlds). So I could have won the Mark Six in a possible world and have decided to take an early retirement, although I cannot, in this disappointing world!

5. Denotational Semantics and Referential Theory of Meaning

This conception of meaning is called the referential theory of meaning. It is also referred to as denotational semantics, and truth-theoretic semantics. We leave aside many complexities surrounding the background of this type of semantic theory and will mainly introduce the working knowledge.

6. Two Types Meaning Studies, in fact Three

- Type I. The study of the language-internal network of meaning relations: Lexical Semantics, Decompositional Semantics; Type II. The study of how words and sentences refer to objects and events/states in the outside
7. Language internal meaning: SENSE

Reference and denotation is one aspect of meaning. The other side of the coin is language internal meaning. Words and phrases are sound-meaning combinations. Put it another way, words encode meaning and sound. A comprehensive study of the lexicon/vocabulary of a language can reveal that every language has a web of meaning. Each word [lexical item] captures a segment of meaning. Words that capture related meaning form special relationships to one another, such as semantic field, hyponymy, synonymy, antonymy, etc. And more relationship can be derived, such as semantic markedness.

- Effability

On the whole, every language can express every kind of meaning it chooses to express. In this sense, all languages are equal in expressive power [This is called effability of language]. But languages can differ from one another in the manners of expression. Some language may have a simple word (with just one morpheme) to express a concept (which is usually in the common vocabulary of the language: pork), whereas some others may have to resort to a more complex construction to express the same concept (such as a compound word, i.e. a word with two or more content morphemes: pig-meat; or a derived word, i.e. a word with some prefix or suffix: antidisestablishementarianism). If a single morpheme is used, it is unanalyzable. That is, its meaning cannot be broken down into smaller parts. But a compound or derivation is decomposable into constituent morphemes, each of which being meaningful.

A semantic field groups together related lexical items according to our knowledge of the world (encyclopedia knowledge): 家具 jia1ju4[furniture] (桌子 zhuo1zi[ table], 餐桌 can1zhuo1[dinner-table], 書架 shuju1[jebookcase], 椅子 yi3zi[chair], 床 chuang2[bed], 衣櫃 yi1chu2[closet], 五斗櫃 wu2dou3chu2[five-drawer case], 沙發 sha1fa1[sofa], 茶幾 cha2ji1[tea-table])

球 qiu2[ball] (足球 zu2qiu2[football], 篮球 lan2qiu2[basketball], 排球 pai2qiu2[volleyball], 乒乓球 ping1pang1qiu2[table-tennis], 羽毛球 yu3mao2qiu2[badminton], 馬球 ma3qiu2[polo], 水球 shui3qiu2[water-polo], 網球 wang3qiu2[tennis], 手球 shou3qiu2[handball], 曲棍球 qu1gun4qiu2[hockey], 冰球 bing1qiu2[ice-hockey]) 壁球, squash

肉 rou4（動物 zhuzhu1rou4[domestic animal], 牛肉 niu2rou4[beef], 羊肉 yang2rou4[mutton], 魚肉 yu2rou4[fish meat], 雞肉 ji1rou4[chicken], 馬肉 ma3rou4[horse meat], 鷄肉 tu4rou4[rabbit meat], 狗肉 gou3rou4[dog meat], 貓肉 mao1rou4[cat meat], 鳥肉 tuo2niao3rou4[ochtrich meat], 龍馬 long2rou4[dragon meat], 果子狸肉 guo3zili2rou4[meat of gem-faced civet]

Hyponymy: 食物 shi2wu4[food] (蔬菜 shuncai4[vegetable], 果菜類【水果 gua1[fruit】，蔬菜类【根菜類【萝卜【胡夢卜】】，水中果【瓜 gua1[fruit】，根菜類【水果【西瓜 xiqu1gua1[sweet melon】，甜瓜 tian2gua1[water melon】，仁果 ren2guo3[pome fruit】，仁果【蘋果 ping2guo3[apple】，梨子 li2zi[pear】，等）、米類 mi3mian4[staple food]

筆, 桌, 筷子, 詩, 詞, 豐富, 豐饒, 香氣, 炒, 包子, 餃子, 毛筆, chopsticks, poem, tsi-poem? code of brotherhood, lofty sentiments: in a spirit of militant pride; filled with militant pride; full of militant spirit; full of pride and enthusiasm, stir-fry, stuffed steam bread, plain steam bread,

Each language forms its own network of meaning and semantic fields.

We use the notion sense to stand for the network of meaning relations in a language. Sense in a language can only be perceived through systematic comparisons between languages or through some special testing cases within a language. That brings us to the topic of markedness:
In (1) and (2), two predicate adjectives are opposite in meaning.

(1) 張三很高。Zhang1 San1 hen3 gao1 “Zhang San is very tall”
(2) 李四很矮。Li 3 Si4 hen2 ai3 “Li Si is very short”

But in other structures, tall and short can be neutralized.

(3) a. 張三有多高？Zhang1 San1 you3 duo1 gao1 “How tall is Zhang San?”
   b. 不高, 才1米68。Bu4 gao1, cai2 yi1 mi3 liu4 ba1 “He is not tall, only 168cm”
   c. 他很高，有1米8。Ta1 hen3 gao1, you3 yi1 mi3 ba1 “He is very tall, reaching 180cm”

In (3a), it is not presupposed that Zhangsan is tall. So both (3b) and (3c) are possible answers. But “tall” is used to cover the whole meaning range. It no longer specifically denote “tallness”, but stands for the neutralization of “tall” and “short”. This is generalized meaning. But we cannot make “short” play the same role.

(4) a. 張三有多矮？Zhang1 San1 you3 duo1 ai3 “How short is Zhang San?”
   b. 才1米68。Cai2 yi1 mi3 liu4 ba1 “Only one metre and 68 cm”
   c. 可他並不矮啊！他有1米8呢！Ke3 ta1 bing4 bu ai3 a ! ta1 you3 yi1 mi3 ba1 ne “But he is not short at all. He is one metre 80 cm”
   d. 他很高，有1米8。Ta1 hen3 gao1, you3 yi1 mi3 ba1 “He is very tall, reaching 1 metre 80 cm”

“short” in (4a) can only denote "short" and cannot cover the “tall” possibility. The speaker in (4) has already presupposed that Zhangsan is short. As a result, (4b) is an appropriate answer to (4a), but (4d) is not. (4c) is not an inappropriate answer, but it has overthrown the presupposition in (4a).

Thus, we see an asymmetry in the meaning and use of 高 and 矮. Similar observations can be made in many other pairs of opposites, such as 大 / 小 da4 xiao3 (big small)、長 / 短 chang2 duan3 (long short)、快 / 鈍 kuai4 dun4 (sharp blunt)、深 / 浅 shen1 qian3 (deep shallow)、重 / 輕 zhong4 qing1 (heavy light)、好 / 壞 hao3 huai4 (good bad)、厚 / 薄 hou4 bo2 (thick thin) …… In these pairs, one word contains a broader range of meaning when it appears in special constructions or usages, whereas the other one only contains its specific and restricted meaning. We term the latter as the marked item containing marked meaning, and term the former as the unmarked item containing unmarked meaning. Markedness is a good indication of the appropriation of meaning in the network of meaning and has nothing to do with the referential aspects of meaning. Different languages reflects different aspects of meaning network, which can be revealed through studies of markedness, synonymy, antonymy, kindship terms, etc.\footnote{Cf. Lyons (1977), 程雨民 (1984), Hofmann (1993, Chapter 2), 張國憲 (1998), 沈家煊 (1999), etc.}

Every language has its internal meaning network, which is termed sense. According to Hurford et al. (2007), the sense of an expression is its place in a system of semantic relationships with other expressions in the language. Or we can redefine sense of an expression as the portion of meaning taken from the overall meaning network of a language that is encoded by an expression. Language change in time, especially its word meaning. And language changes to outwit changes. That means the internal meaning network will always regulate itself, to accommodate new words and newly coerced meaning, while covering up the gaps of meaning left by the discarding of obsolete words. No two languages are the same in this respect. But every language can express all kinds of meaning, one way or another, if it so wishes.
8. Frege’s Meaning Experiment

There is a simple method to distinguish sense from reference, first introduced by Frege (1892). Two expressions may have exactly the same reference, but they may still differ in meaning.

1) The morning star is a planet
   The morning star = the evening star
   The evening star is a planet

2) Babylonians believed that the morning star was a goddess.
   The morning star = the evening star
   Babylonians believed that the evening star was a goddess.

3) Necessarily, the morning star is the morning star
   The morning star = the evening star
   Necessarily, the morning star is the evening star

Although we are ready to accept the inference in (1), we are not ready to accept the inferences in (2) and (3). That the morning star is the morning star is an uninteresting repetition. Yet to say that the morning star is the evening star embodies a piece of scientific discovery. Sameness in reference does not guarantee sameness in meaning. There is meaning other than reference. Meaning minus reference is sense.

References:
程雨民 (1984). 語義關係的若干類型，《現代英語研究》，第 1 輯 總 13 期，1 - 9 頁。
張國憲 (1998). 語言單位的有標記與無標記現象，《句法結構中的語義研究》，邵敬敏主編，北京語言文化大學出版。
沈家煊 (1999). 《不對稱和標記論》，南昌：江西教育出版社。
1. Propositional Calculus

Some simple systems of semantics have already been constructed by logicians. They are propositional calculus and predicate calculus. We start with some basics of propositional logic, i.e. its representational conventions.

Ever heard of the term “compound sentences” in grammatical studies? A compound sentence contains two clauses with more or less equal status, linked together by some logical relations. So “compounding” is different from “embedding” or “relativization” in syntax. Compounding is achieved by using connectives and conjuncts. Connectives like “and”, “or” and “but” connects conjuncts of equal status. Some others, such as “if”, “because”, “though” introduce subordinate clauses to superordinate ones. The latter are compounds in a loose sense.

In propositional calculus, we do strict compounding, i.e. only with ∧ (conjunction 合取), ∨ (disjunction 析取), → (material implication 實質蘊涵), ↔ (biconditional 雙向條件式), but also with ~ (negation 否定). The first four are infix operators, and the last, prefix operator. Note that ~S is not considered a compound in syntax. But in logic, it is a compound proposition. Thus the following are well-formed formulae:

\[
\begin{align*}
\text{(1)} & \\
\text{i.} & \quad P \\
\text{ii.} & \quad P \land Q \\
\text{iii.} & \quad P \lor Q \\
\text{iv.} & \quad P \rightarrow Q \\
\text{v.} & \quad P \leftrightarrow Q \quad \text{(derived)} \\
\text{vi.} & \quad \neg P \\
\text{vii.} & \quad \neg \neg P \quad \text{(derived)}
\end{align*}
\]

Question: how to turn the above formulae into generic ones?
Answer: we resort to a meta-language, in which each symbol stands for a formula in object language.

\[
\begin{align*}
\text{(2) Let } & \quad A \text{ and } B \text{ be wff. , then } \neg A , \quad A \land B , \quad A \lor B , \quad A \rightarrow B , \quad A \leftrightarrow B \text{ are wffs. All other formulae are not.}
\end{align*}
\]

Exercise: Translate the following into propositional logic:
1. 掛八號風球了！The NO. 8 Strong Wind Signal has been hoisted.
2. 天黑了。It gets dark.
3. 張三喜歡李四。Zhang San Likes Lisi.
4. 你要麼喝杯奶茶, 要麼喝杯鴛鴦。You either drink a cup of white tea or you drink a cup of Yuanyang [half tea and half coffee]. (P \lor Q) \land \sim (P \land Q)
5. 他查了語義學的教材, 又查了語用學的教材。He looked the question up in semantic textbooks, and he looked up the pragmatic books too.
6. 他學過鋼琴, 又學過小提琴, 還學過古箏呢。He has taken piano classes, and violin classes too, and even classic harp classes.
7. 如果我中了六合彩頭獎, 我馬上就辭職! If I won the Mark Six, I would quit right away.
8. 如果雪是白的, 那麼草是綠的。If snow is white, then grass is green.
9. 並非人人都喜歡你。It is not the case that everyone loves you.
10. 並非人人都不愛看《紅樓夢》。It is not the case that no one loves to read the Dream of the Red Mansions.
2. Truth-Tables

The meaning of compound formulae is given in the form of truth tables. Here are the basic ones linked to the basic connectives.

<table>
<thead>
<tr>
<th>P</th>
<th>0</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\neg P)</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
<th>1</th>
</tr>
</thead>
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<tr>
<td>1</td>
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<td>1</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\[P \leftrightarrow Q = (P \rightarrow Q) \land (Q \rightarrow P)\]

Exercise: Give the truth-table of \(P \leftrightarrow Q\).

Many connectives in natural language are not represented here as logical connectives, because they are not truth-functional. That is, given the values of the conjuncts, the overall truth value cannot be worked out. An example is “because”:

Here are some special constructions:

1. 只要有水，莊稼就能活。So long as there is water, the plants can survive.
2. 只有用強力洗衣粉洗，才能把這件襯衫的衣領洗白。The shirt-collar can be well cleaned only if Super AXE laundry powder is used.
3. 你要是早點動手寫論文，現在就不至於幾個星期不睡覺還寫不完。If you had worked on the essay earlier, you would not have worked away on end for several weeks without finishing it.
4. 金無足赤，人無完人。（韋世林《漢語邏輯相應相異論》Wei, Shilin. *On the Similarities and Differences between Chinese and Logic.*）Gold can be pure if and only if a man can be perfect.
(5) 不論你們是否同意，反正我明天開始不來上班了。Whether you agree or not, I will not come back tomorrow.
(6) 不管我怎麼去想，我不受歡迎這件事都是你們的錯。No matter how I take it, the fact that I am not popular is all your fault.
(7) 我跟她的戀情已經完了，如果你想追她的話。She and I are finished, if you want to have a go.
(8) 我想獨處一會兒，如果你不介意的話。Can I be left alone, if you don’t mind?
(9) I am going to have a go, if anyone wants a drink?
(10) If you mow the lawn for me, I will give you five pounds. (only if)

3. Why is ‘because’ not a logical word?

‘because’ is not truth-functional. That is, given the truth or falsity of the two clauses, there is no fixed logical consequence stemming from them, for the whole compound sentence.

A because B
If either of A and B is false, then you can say the final S is false.
What if both A and B are false? Is the whole S true or false? One may be tempted to say it is false.
If A and B are both true, the whole S can either be true or false. [That means it is not a logical connective: you cannot predict a fixed value from the fixed values of its constituents.]

Cases:

PolyU is in Hung Hom because CUHK is in Tai Po.
The weather is very hot because it is early September.
Brutus killed Cæsar because he [= BRUTUS] loved Rome more.
Brutus killed Cæsar because he [= BRUTUS] was his [= CÆSAR] adopted son.
Brutus killed Cæsar because he [= BRUTUS] hated his [= CÆSAR] new marriage.
Brutus killed Cæsar because he [= Brutus] wanted to be remembered in history.

Compare the above with sentences containing "and ∧", "or ∨", "not ¬", "if ... then, →", "if and only if, ↔"
1. Representing Meaning with Predicate Logic

Predicate Logic retains almost all the rules of propositional logic with the exception that it represents propositions differently by introducing internal structures. That is, it can get inside a proposition. To start with, a formula in predicate logic contains predicates and arguments. While an atomic proposition is represented simply as P in propositional logic, in predicate logic, it is represented in the form of (1):

\[ P(a_0...a_n) \]

where \( P \) stands for a predicate, and \( a_i \) stands for an argument in \( i \) position.

When translating a natural language sentence into a predicate logical formula, use the main predicate to replace the \( P \) in (1) and use the subject and the object to replace the “\( a_0...a_n \)” in (1). This is not the whole picture yet, but it serves as a convenient starting point.

Take a look at the following sentences, which should be represented as (4) and (5) respectively. Here, no arguments are involved. So we only use the predicates.

(2) It rains.
(3) 起(qi3, start)風(feng1, wind)了(le, sentence-final particle introducing an event) "The wind blows".
(4) Rain.
(5) BLOW-WIND. [Note that (3) is conventionally treated as a subjectless sentence. Just like (6)]
(6) 下(xia4, fall)雨(yu3, rain)了 "It rains"

The following involves natural language sentences with only one argument, i.e. the subject. Their logical formulae in predicate logic are given by the side:

(7) John smiles. \[ SMILE (john) \]
(8) Peter sleeps. \[ SLEEP (peter) \]
(9) Mary is happy. \[ HAPPY (mary) \]

Some conventions:

a. Write the predicate before the argument(s).
b. Write the predicate in small capitals.
c. Write arguments in small letters, even if names are involved.
d. Put arguments in a pair of parenthesis so as to draw the boundary between the predicate and the arguments. (Other logic textbooks may differ.)
e. Treat "be + predicative adjective" as a single predicate.
f. Put a comma between arguments. (We come to this point presently.)
g. When doing translation, leave out the grammatical suffixes, because what gets translated is meaning, not grammatical specifications. Likewise, at this initial level, an active sentence and its transformed passive construction get translated into exactly the same logical formula.

Exercise 1:

(10) Sam cries.
(11) Joan blushes.
(12) Mt. Everest is white.
(13) London is huge.
(14) Sam is British.
Turning to natural language sentences containing predicates with two arguments. Such a predicate should have two slots reserved. That is, it takes the form of $P(a_1, a_2)$. A predicate having two places for arguments is also called a two-place predicate. It is also called a two-arity predicate. Now we can attempt to translate the following sentences into predicate logic:

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Predicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(15) John loves Mary.</td>
<td>LOVE (john, mary)</td>
</tr>
<tr>
<td>(16) Peter visited Shanghai.</td>
<td>VISIT (peter, shanghai)</td>
</tr>
</tbody>
</table>

It is in the lexicon that the arity of a predicate is specified. If a predicate can either take one argument or two, it is two predicates in disguise. That is, it means two predicates happen to share the same form. Sometimes, a two-place predicate may take only one argument in the sentence because the other argument is omitted. That is a case of ellipsis.

Sentences containing predicates with three arguments can also be found. Such a predicate is called a three-place predicate, taking the form of $P(a_1, a_2, a_3)$. Some examples are: *introduce, give, place, tell, teach* (note that some of the three-place verbs have other uses, i.e. two-place or intransitive uses).

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Predicate</th>
</tr>
</thead>
<tbody>
<tr>
<td>(17) Bill introduced Peter to Mary</td>
<td>INTRODUCE (bill, peter, mary)</td>
</tr>
<tr>
<td>(18) Sam gave the book to Jill</td>
<td>GIVE (sam, the-book, jill)</td>
</tr>
<tr>
<td>(19) John told Dan the story</td>
<td>TELL (john, the-story, dan)</td>
</tr>
<tr>
<td>(20) Susan taught him “I Ching”</td>
<td>TEACH (susan, i-ching, a)</td>
</tr>
</tbody>
</table>

Questions for discussion:

- When translating a di-transitive sentence, which argument order should be followed? [1]
- How to translate definite noun phrases? [2]
- How to translate pronouns? [3]

When it comes to translating compound formulae, we still follow the conventions of propositional calculus. Conjoining (15) and (17) will give us (21), and (8) and (20) can also be joined together by a biconditional, yielding (22):

(21) $\text{LOVE (john, mary)} \land \text{INTRODUCE (bill, peter, mary)}$
(22) $\text{SLEEP (peter)} \leftrightarrow \text{TEACH (susan, i-ching, peter)}$ [What have I done to the pronoun?]

Up to now, the language of predicate logic seems very limited in its expressive power, because only names or equivalents can serve as arguments. Think about propositional logic. There, any statement can be represented. But predicate logic is certainly more expressive. The arguments can be taken by both constants and variables. Logical constants have fixed denotata (singular form: \textit{denotatum $=$} the actual object referred to by a linguistic expression.). But they can only be used to refer to named or definite individuals. In order to talk about unnamed or indefinite individuals, we need to use variables as arguments. Let us take a look at the following

(23) $\text{SLEEP (x)} \land \text{DRINK (x)}$
(24) $\text{SLEEP (x)} \land \text{DRINK (y)}$

(23) says some individual sleeps and drinks. But it is not specified how many such individual is being considered. (24) says some individual sleeps, and someone else drinks. Again, it is not stated how many such individuals are involved. In both these cases, we have variables as arguments. What is more, each variable is free, meaning that we do not know how many individuals each variable stands for. But once the quantifiers are introduced, things become clearer. In predicate

---

2 [1] Predicate(subject, direct object, indirect object). [2] At this stage, treat them as names. [3] A pronoun is a place-holder. At this stage, pretend that you can identify its antecedent. Then treat it as a name.
logic, there are two standard logical quantifiers, \( \forall \) and \( \exists \). \( \forall \) is the universal quantifier. It can be pronounced as “(for) all” and taken as a capital “a” letter turned upside-down. \( \exists \) is the existential quantifier often pronounced as “(there) exists” and can be taken as an inverted capital “e” letter.

(25) \( \forall x \, \text{SLEEP}(x) \). [For all \( x \), \( x \) sleeps (including human individuals.)]

(26) \( \exists x \, \text{SLEEP}(x) \). [There exists at least one \( x \) such that \( x \) sleeps.]

Obvious, more qualifications are in order, so we need to give more complex formulae to express more precise thoughts:

(27) \( \forall x \, (\text{BOY}(x) \rightarrow \text{SLEEP}(x)) \). [For all \( x \), if \( x \) is a boy, then \( x \) sleeps.]

(28) \( \exists x \, (\text{BOY}(x) \land \text{SLEEP}(x)) \). [There exists at least one boy such that he sleeps.]

An existentially quantified formula comes with an existential presupposition. That is, the mentioned individual is assumed to be in existence. Hence, the main connective associated with existential quantification is conjunction. \(^3\) Think of the truth-table of the conjunction, if one conjunct is false, the whole formula is false. If the existence of the individual turns out to be false, the whole formula is false.

But a universally quantified formula does not have existential presupposition. In (27), if \( x \) is a boy, then he sleeps. The whole formula is true. But if \( x \) is not a boy, the whole formula is still true, according to the truth table of the conditional. Here, the main connective is the conditional sign. If we replaced it with a conjunctive operator, it will give us the wrong meaning, as shown by (29):

(29) \( \forall x \, (\text{BOY}(x) \land \text{SLEEP}(x)) \). [For all \( x \), \( x \) is a boy and \( x \) sleeps.]

(29) gives the wrong representation because it says everything (in the world) is both a boy and sleeps. When an individual is not a boy, the formula collapses. On the other hand, (30) is also wrong because it lacks the existential presupposition: if no boy exists, the formula is still true. So (30) gives us the wrong prediction on existential quantification.

(30) \( \exists x \, (\text{BOY}(x) \rightarrow \text{SLEEP}(x)) \)

2. Model-theoretic Interpretation in Predicate Logic

The semantics of predicate logic differs from that of propositional logic. In the latter, the atomic propositions need to have their truth values verified in the real world first. Then the truth values of the compound propositional formulae can be mechanically determined using truth-tables of the logical connectives that are involved in the formulae. If the truth values of the atomic propositions are not known, we can work out all the combinatorial possibilities of the compound formulae by giving each atomic proposition two values, 0, 1, one at a time. The result is a list of exhaustive assignments of truth values and comprehensive computations of their combinatorial results.

In predicate logic, since we can get inside a proposition, we can take a step further by formulating the truth-conditions under which a proposition with given structural properties can be true. And we can test if a given proposition is true or false against the external world in finer ways. To attain this goal, we need to construct a model: a mini-world that contains fewer things than the actual external world so that we can find it more manageable. We could have used a real-world scene, but that would still be unnecessarily complicated, like the following pictures:

\(^3\) “main connective” is specified as the connective that must be used together with a quantifier. If the formula is complex, there may be other connectives.
For the purpose of doing semantic interpretation, a much simpler sketch of a model will suffice, like Model 3 below:

\[ M^3 \]

\[
\begin{align*}
\text{a, b, c, d, e, f, g, h, i, j, k, l} \\
\text{BOY} = \{\text{a, b, c}\}, \text{PEOPLE} = \{\text{a, b, c, d, e, f}\} \\
\text{GIRL} = \{\text{d, e}\} \\
\text{HAPPY} = \{\text{a, b, c, d}\} \\
\text{CRY} = \{\text{e}\} \\
\text{LOVE} = \{<\text{a, d}>, <\text{b, e}>, <\text{e, b}>\}
\end{align*}
\]

Given a model \( M^3 \), its domain should contain some individual entities, which are associated with some expressions in a language. It should also contain some sets, which are related to some predicates in a language.

To interpret a formula in predicate logic is to give it a denotational interpretation, which involves computing its truth value. From a denotation-theoretic point of view, a formula in predicate logic can be interpreted according to the following truth-conditions:

\[
\begin{align*}
(31) & \quad \text{PRED}_0 = 1 \text{ or } \text{PRED}_0 = 0 \text{ [Since there is no internal structure, such a formula is just like an atomic proposition and is so evaluated.]}
(32) & \quad \text{PRED}_1(\text{arg}_1) = 1 \text{ iff } [\text{arg}_1]^M \in [\text{PRED}_1]^M \text{ [The argument here should be a constant. Since a one-place predicate denotes a set of individuals, the argument should be a member of the set to make the formula true.]}
(33) & \quad \text{PRED}_2(\text{arg}_1, \text{arg}_2) = 1 \text{ iff } [<\text{arg}_1, \text{arg}_2>]^M \in [\text{PRED}_2]^M \text{ [Again, only constants are being considered. What should be reminded is that a two-place predicate denotes a set whose members are ordered pairs of individuals.]}
(34) & \quad \text{Now you can work out the truth-condition for a structure containing a three-place predicate.}
\end{align*}
\]
If arguments are assumed by one or more variables, an additional value assignment function for variables is added to the interpretation process, with the result that now we have $[a]^{M3g3}$, where $g$ is the additional variable valuation function. The function $g$ works in the manner illustrated as (36):

(35) Value assignment for variables [valuation function]

\[
\begin{array}{cccc}
\text{【}x\text{】}_{M3g1} & \rightarrow & a \\
\text{【}x\text{】}_{M3g2} & \rightarrow & b \\
\text{【}x\text{】}_{M3g3} & \rightarrow & c \\
\text{【}x\text{】}_{M3g4} & \rightarrow & d \\
\text{【}x\text{】}_{M3g5} & \rightarrow & e \\
\ldots & \cdots \\
\text{【}x\text{】}_{M3g_n} & \rightarrow & n \\
\end{array}
\]

Take the above graph as a process showing how an argument variable in a predicate logical form is given a tentative value. When a value is assigned, a given constant replaces the variable in the logical form as shown by (36) – (38). Then the logical formula can go on with its truth-evaluation process until a truth value is computed. Note that the following interpretations are conducted with reference to the Model 3 as given above.

(36) John loves everyone. $\forall x \ (\text{PEOPLE}(x) \rightarrow \text{LOVE}(j, x))$

(37) $\text{【}john\text{】}_{M3} = f,$

$\text{【}x\text{】}_{M3g1} = a,$

$\text{PEOPLE}(x/a) \rightarrow \text{LOVE}(j, x/a)$ [x/a means “using a to replace x”]

$a \in \text{【}\text{PEOPLE}\text{】}_{M3}$

$\langle f, a \rangle \not\in \text{【}\text{LOVE}\text{】}_{M3}$

$\langle f, a \rangle \not\in \{ \langle a, d \rangle, \langle b, e \rangle, \langle e, b \rangle \}$

$\text{【}\forall x \ (\text{PEOPLE}(x) \rightarrow \text{LOVE}(j, x))\text{】}_{M3} = 0$

The question is: how many assignments need to be performed? That is, when does the valuation machine grind to a halt? Answer: it depends on the nature of the quantifier that binds the variable. A universal quantifier requires its valuation to be exhaustive, unless a 0 is reached before the domain is exhausted. An existential quantifier requires its valuation to identify just one true instance and will not stop its valuation until it finds one. Suppose the domain contains infinite members. Then, in the case of universal quantification, if no false case is found, the valuation machinery will not stop, and in the worst case, the truth of the whole formula can never be established. In the case of existential quantification, if no true case is found, the valuation machinery will also keep on grinding, and in the worst case, since a true instance cannot be found and the domain is infinite, the truth of the whole formula can never be established either.

3. More definitions

Summing up, predicate calculus enables us get into the sentence and study its argument structures. In predicate calculus, we need to distinguish between names and variables. Variables can be bound by quantifiers (or other types of operators such as the $\lambda$-operator), or they can be free. There are only two quantifiers in first-order predicate logic, $\forall$ and $\exists$. $\forall$ is called the universal quantifier, and $\exists$, the existential quantifier. $\forall$ means each and every instance ranging over the variable it binds should satisfy a property. $\exists$ means at least one instantiation of the variable it binds should satisfy a property. For complex logical forms, universal quantification and existential quantification take on different canonical patterns:

1. $\forall x \ (Fx \rightarrow Gx)$
2. $\exists x \ (Fx \land Gx)$
A formula containing variables but no binding quantifiers is called a propositional function, or an open proposition, in which the unbound variables are called free variables.

The Semantics of Predicate Logic

I. Vocabulary:
   - A set of predicate, represented by capital letters.
   - A set of individual constants, represented by small non-italicized letters, a, b, c, ..., etc., excluding x, y, z. 個體常項由正楷小寫字母表示，不包括 x, y, z.
   - A set of individual variables x, y, z, represented in small italicized letters. 個體變項由斜體小寫字母 x, y, z 表示.
   - A set of operators: 算子
     - ~, ∀, ∃ are prefix operators; 前置算子 ~, ∀, ∃
     - ∧, ∨, →, ↔ are infix operators; 中置算子 ∧, ∨, →, ↔

II. Syntax

The syntax of propositional logic applies, only that a proposition is represented here in a compositional way, in the form of Predicate + a certain number of individuals. 議詞邏輯的句法基本全部承襲了命題邏輯的句法，惟有議詞邏輯中的命題被分解出各個成份，其形式為 議詞+一個或多個作為論元的個體，個體進一步分為常項和變項，變項又由量化詞約束，這些內容是命題邏輯所沒有的。

∀, ∃ are quantifiers, used together with some variables, in the form of ∀xPx or ∃xPx, where the quantifier binds the variable. ∀, ∃ is 邏輯量化詞，與某個變項構成量化結構的前束式 quantifier prenex，約束命題中的論元變項。

III. Semantics

Pa is true iff \([a]^{M_1} \in [P]^{M_1}\), where \([a]^{M_1}\) denotes some individual entity and \([P]^{M_1}\) denotes a set of entities.

Pa 為真當且僅當 \([a]^{M_1} \in [P]^{M_1}\)，其中 \([a]^{M_1}\) 指謂某個個體且 \([P]^{M_1}\) 指謂個體集合。

Pab is true iff \([a, b]^{M_1} \in [P]^{M_1}\), where \([a, b]^{M_1}\) denotes an ordered pair and \([P]^{M_1}\) denotes a set of ordered pairs.

Pab 為真當且僅當 \([a, b]^{M_1} \in [P]^{M_1}\)，其中 \([a, b]^{M_1}\) 指謂一個有序偶且 \([P]^{M_1}\) 指謂一個由有序偶組成的集合。

P(x_1, ..., x_n) is an open proposition, also called propositional function, whose truth value depends on each assignment of the value of the variables. That is, each value assignment of each and every variable in the formula obtains a distinct truth value.
Exclusive disjunction is different from inclusive disjunction in the sense that it does not allow both the disjuncts to be true. Hence it has the following truth-table:

<table>
<thead>
<tr>
<th>P</th>
<th>P\lor\neg Q</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Examples in natural language are the following:

1. Either you are mad or I am.
2. Either you go or I go.
3. I will have either tea or coffee.
4. 不 是 你 死, 就 是 我 亡。 “Either you die or I die.”
   [Contrast it with the superficially illogical 不是 你 死, 就 是 我 活] “Either you die or I live(die)”

Is it absolutely necessary for us to define a new exclusive disjunction $\lor$? Not really, because we can represent exclusive disjunction in terms of the following formula:

$$ (P \lor Q) \land \sim (P \land Q) $$

Since we do not touch on logical proof in this subject, I won’t show you how to prove that (5) and $P \lor Q$ are equivalent, i.e. from one, we can infer the other by applying rules of deduction. But we can at least show that they are equivalent through truth-tables. The following is the truth-table for (5).

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
<th>$\lor$</th>
<th>$\land$</th>
<th>$\sim$</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>1</td>
<td>1</td>
<td>0</td>
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<td>1</td>
</tr>
</tbody>
</table>

The final result

8. The Biconditional

The biconditional $\leftrightarrow$ is not a basic connective, because it can be decomposed to a conjunction of two conditionals, as shown by (6) below. Hence $\leftrightarrow$ is just a convenient shorthand sign.

$$ (P \leftrightarrow Q) = (P \to Q) \land (Q \to P) $$

<table>
<thead>
<tr>
<th>P</th>
<th>Q</th>
<th>$\to$</th>
<th>Q</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
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</tbody>
</table>
9. **Sufficient and Necessary Conditions**

\[(\neg A \rightarrow \neg B)\] is equivalent to \[(\neg B \rightarrow \neg A)\]. This is called contraposition.

This, while a sufficient condition is represented as \((P \rightarrow Q)\), we can represent a necessary condition as \((Q \rightarrow P)\), which will be equivalent to \((\neg P \rightarrow \neg Q)\), which is exactly what we want to say in expressing a necessary condition.

10. **Using Negation and Disjunction to Define Conditional**

It can be proven that \((\neg A \rightarrow \neg B)\) is equivalent to \((\neg A \lor \neg B)\). Hence the following should also obtain:

1. If you are tired of London, you are tired of life. \(P \rightarrow Q\)
2. If you are not tired of life, you are not tired of London. \(\neg Q \rightarrow \neg P\) (contraposition, from 1)
3. Either you are not tired of London, or you are tired of life. \(\neg P \lor Q\) (from 1)
4. Either you are not not tired of life, or you are not tired of London. (from 2)
5. Either you are tired of life, or you are not tired of London. (double negation, from 4)

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**Semantics: Sample Test with answer key**

Time: 90 minutes

Answer all the questions.

1. **What is the difference between denotation and reference?** Use at least one example to illustrate your explanations. (20%)

   Ans: Denotation is the potential possibility of an expression in being related to some entity in the world. Reference is the actual use of an expression in an utterance to point to some entity in the world. Example: “the book”: its denotation can be described as “a unique, paged publication for reading”, while its use in the following sentence may refer to an actual book copy titled Les Miserables.

   Speaker A: I have always wanted to read the book but find it too long to finish.

2. **What is sense?** Give one example to show how we can perceive the existence of sense. The example should not be any one already mentioned in lecture notes. (20%)

   “Sense” is the meaning network of a language. The sense of a word is the portion of meaning segmented from the overall meaning network that is encapsulated in the linguistic unit (i.e. a slice of meaning taken from the meaning network that is encoded in a linguistic unit). Sense can be perceived through the study of special symmetric and asymmetric relations in the lexicon, sometimes through inter language comparisons. Examples: verbs related to cooking in Chinese sometimes have no equivalents in English, showing different semantic fields in the two languages.

3. **Why can the meaning of statement sentences be equated to truth-conditions?** (20%)

   Because the meaning of statement sentences can be equated to propositions. Propositions carry truth values. A proposition is true if it gives a true description of the event or state in the world. Otherwise, it is false. Therefore, the meaning of a proposition can be related to truth values. But it is not possible nor necessary for us to know...
the exact truth value of a proposition in order to study its meaning. All we need to do is to exhaust its meaning possibilities by specifying under what conditions it is true. Once we spell out the truth conditions of a proposition, its literal meaning can be taken as adequately described. Hence the meaning of statement sentences can be equated to truth-conditions.

4. Compute the truth values of the following by using truth-tables:

   a. \( \sim P \rightarrow (P \rightarrow Q) \)  
      \[
      \begin{array}{cccccc}
      \sim P & \rightarrow & (P & \rightarrow & Q) \\
      0 & 1 & 1 & 1 & 1 \\
      0 & 1 & 1 & 0 & 0 \\
      1 & 0 & 1 & 0 & 1 \\
      1 & 0 & 1 & 0 & 1 \\
      \end{array}
      \]

   b. \((P \land Q) \land \sim (P \leftrightarrow Q)\)  
      \[
      \begin{array}{cccccc}
      (P & \land & Q) & \land & \sim (P & \leftrightarrow & Q) \\
      1 & 1 & 1 & 0 & 0 & 1 & 1 \\
      0 & 0 & 0 & 0 & 0 & 1 & 0 \\
      1 & 0 & 0 & 1 & 1 & 0 & 0 \\
      0 & 0 & 1 & 0 & 1 & 0 & 1 \\
      \end{array}
      \]

5. Translate the following into propositional logic  
   (10%)

   Either you are mad or I am, but not both.

   \((P \lor Q) \land \sim (P \land Q)\)

6. Translate the following into an English sentence  
   (10%)

   \( \forall x \ (\text{BOY } x \rightarrow \sim \text{LIKE } (x, \text{jim})) \).

   Ans: No boy loves Jim.