5118008 English for Software Developer

Relative Clauses and Adverbs

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Relative Pronoun

- A relative pronoun joins an independent clause and a relative clause
  - Ex. Who, Whom, Which, What, That, Whom, etc.
  - An independent clause precedes, and a relative pronoun and a relative clause follow
  - A relative pronoun works as the subject or object in the relative clause

- Two use cases
  - To modify the antecedent (restrictive clause)
  - To add more information about antecedent (non-restrictive clause)
  - Ex.
    - Like almost everyone who uses email, I receive a ton of spam every day
    - She reported the incident to the company's vice president of sales, who refused to take action.
    - Allyn Jackson is a journalist specializing in science and mathematics, who is based in Germany.

Who

- Refer to a person as the verb's subject
  - Examples
    - These kinds of implicit assumptions about the state of a large and complex program are easy to miss for a developer who is familiar with only parts of the whole
    - We also found faculty who are conducting research on the effectiveness of these tools in teaching.

- Put a comma in front of "who" when it is used to give additional information, not to modify
  - The same for "whom", "whose" and "which" (not for "that")
  - Example
    - This fragility of automatic proofs of functional correctness has a cost for users, who need to occasionally repair the proof.

Whom

- Refer to a person as the verb's object
  - However, nowadays people often use "who" instead of "whom"

- A preposition may come before "whom" if it is needed to connect "who" with the verb in the relative clause
  - the same for "who", "whom", "whose", "which" (not for "that")

- Examples
  - Much research shows people communicate online primarily with people with whom they communicate offline.
  - He explained how the data was secured in Google's Firebase, accessible only to him and to whom the user grants permission.
  - ChatGPT confidently decided that she was talking to her older brother, whom she would call *oppa*, while he used her name.

Whose

- Possessive form of who and which
  - refer to both a person and a thing
  - for a non-human thing, whose works as "the owner of which"

- Examples
  - A system whose security depends on its design and implementation being secret is likely to have brittle defenses.
  - We assume a directed graph whose nodes are labeled by integers between 1 and n
  - The social protest created a social infrastructure, whose contribution to the current war is significant and crucial.

Which

- Refer to an animal or thing as the verb's subject or object
    - in a non-restrictive clause, or
    - in a restrictive clause when coupled with a preposition

- Example
    - A new era is emerging in which artificial intelligence (AI) will play an ever-increasing role in many facets of daily life.
    - To ease this stress, Harvard freshman Yuen Ler Chow developed the facial recognition software called The FaceTag,7 which links to a database of fellow Harvard students' contact information.
    - They proposed a security notion called virtual black box (VBB), which ensures an obfuscated program does not reveal anything more than black-box executions of the program.

That

- Refer to an animal or thing as the verb's subject or object
  - in a restrictive clause
  - never to a person
  - never with a preposition or comma

- Examples
  - Alice can encrypt a secret message to Bob by obfuscating the program that only outputs the message when given Bob's correct secret key as an input.
  - The line will also be difficult to draw when people use AI-powered editing tools to manipulate a work that was initially human-authored, or adds significant human authorship to an image that was initially AI-generated.

What

- We can use "what" in the place of an antecedent
  - means "something that"

- Examples
  - Such case studies would help to clarify what is currently feasible and what is not feasible when employing XAI techniques.
  - We need to teach students how to determine what the code does, even if that code may be more complex than what they've been taught in class
  - What really matters is that the newest technology now supports writing stuff like this, at scale, and far more fluently than before.

Relative Pronoun with Quantifiers

- Relative pronouns are often used together with quantifiers and numbers
  - all of which/whom, most of which/whom, many of which/whom, some of which/whom
  - one of which/whom, two of which/whom
- When it is with a quantifier, "whom" is used instead of "who"
- Examples
  - Moreover, there can be multiple objectives, some of which must be satisfied together and others that may need to be traded off against each other in certain environments.
  - Within three weeks the 57,000-plus players, most of whom had no training in molecular biology, had the answer, which was subsequently published in the journal Nature Structural and Molecular Biology

Compound Relative Pronouns

- Whoever, whomever, and whatever

- Means "no matter who/whom/what"

- Apply universally to a number of people or things

- Example
  - Russian President Vladimir Putin says that whoever reaches a breakthrough in developing artificial intelligence will come to dominate the world.
  - The belief is that if students learn the concepts well, then the students can simply apply it to whatever language they learn next.

Relative Adverb

- Introduce adjective clauses that specifies a location, time and reason
  - When, Where, Why, How
  - "Why" mostly come together with "the reason"; "How" does not come together with "the way"
- Example
  - This conjecture was disproven in 1993 when the counterexample n = 35 was discovered by exhaustive computer search
  - Social media is perhaps the area where legislation intersects most colorfully with public engagement
  - One reason why the motion-planning problem is computationally hard is due to the complexity of computing obstacles in C-space.
  - The phenomenon is also of interest since it illustrates a key difference between the way humans and AI learn different tasks

Compound Relative Adverb

- Whenever, Wherever, However
  - means "no matter when/where/how"

- Examples
  - Synthesis procedures are predictable, because they are guaranteed to find code that satisfies the specification whenever such code exists.
  - You can copy an immutable file whenever and wherever you want and share the immutable copies across users.

Common Mistake

- That's the school that it does lots of music and drama.

- They met at the gallery that had talked about.

- They went to the same restaurant that Mark had been to it.

- Sally is a committee member, who finds it difficult to make decisions

- Mary is a CEO of the corporation, which produces a wide range of products on international level.

- My office is about hundred meters from the center, which I share with my colleague.

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