Lecture 12 :

How To Write a Scientific Paper

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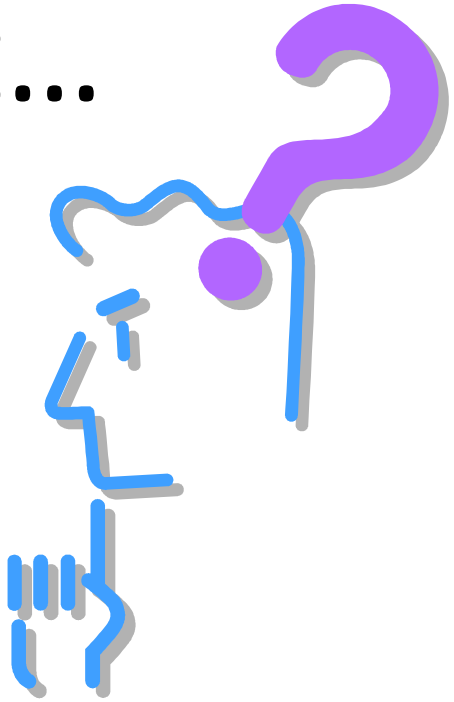
Overview

- Task of writing a research paper can be daunting
- Even with ground-breaking research, unless the paper is correctly written:
  - at best, publication will be delayed
  - at worse, never published
- Presentation will provide an overview of “how to write a well-structured research paper for publication”

The questions to ask yourself first…



Is the paper worth writing?

- What is in the literature?
- “ So What? ”
- It’s a lot of work (average 20-30 drafts).
  - Don’t do it unless its worth it.

What do I have to say?

- A single question clearly stated with adequate evidence for the answer.
- Try stating the question and its answer in one simple sentence.

OK, So you want to/need to write a paper --> next questions

- What is the right format for the message ?
- What is the right audience—who cares?
- What journal should I choose?

Which journal?

i. Is topic of my paper within its scope and format?

ii. Would it match my audience?

iii. Ask mentor or other senior researchers: appropriateness

iv. Impact Factor

v. Consequences of wrong decision: time lost; failure to publish

Calculation for journal impact factor*

A= total cites in 2015

B= 2015 cites to articles published in 2013-14 (this is a subset of A)

C= number of articles published in 2013-14

D= B/C = 2015 impact factor

**Weights review articles heavily and is higher in scientifically better populated fields*

Use an outline to organize your ideas and writing

- List the key ideas to be covered under each heading. Organize your thinking logic and the logic of your arguments at this level, not when you are trying to write complete, grammatical, and elegant sentences.

- Separate out the three tasks of: (1) figuring out what you want to say, (2) planning the order and logic of your arguments, and (3) crafting the exact language in which you will express your ideas.

Know your audience and write for that specific audience

- Scientific and technical writing is never a ‘general purpose’, but written for a specific audience, i.e. the community who read a particular journal or study a particular subject.

- You must adopt the style and level of writing that is appropriate for your audience. Study them as they are manifested in a selection of highly regarded papers and in the ‘Instructions for Authors’ for key journals.

Author versus Reader Behaviour

- **Author behaviour**
  - Want to publish more
  - Peer review essential
  - Other journal functions crucial
  - Wider dissemination
- **Reader behaviour**
  - Want integrated system
  - Browsing is crucial
  - Quality information important
  - Want to read less

Elsevier study of 36,000 authors (1999-2002) presented by Michael Mabe at ALPSP Seminar on “Learning from users” 2003; www.alpsp.org

The Process of Paper Writing

- Create an outline first
- Plan on multiple drafts:
  - Filename with dates
  - One filename written over with new draft
- Tables/figures early: prompt more analysis
- Deadlines for you and coauthors

Structure of a Paper

Scientific writing follows a rigid structure – a format developed over hundreds of years.

Consequently, a paper can be read at several levels:

- Some people just will refer to the title
- Others may read only the title and abstract
- Others will read the paper for a deeper understanding

Components of a Paper

Section	Purpose
Title	Clearly describes contents
Authors	Ensures recognition for the writer(s)
Abstract	Describes what was done
Key Words (some journals)	Ensures the article is correctly identified in abstracting and indexing services
Introduction	Explains the problem
Methods	Explains how the data were collected
Results	Describes what was discovered
Discussion	Discusses the implications of the findings
Acknowledgements	Ensures those who helped in the research are recognised
References	Ensures previously published work is recognised
Appendices (some journals)	Provides supplemental data for the expert reader

Title

- Describes the paper’s content clearly and precisely including keywords
- Is the advertisement for the article
- Do not use abbreviations and jargon
- Search engines ***/*** Indexing databases depend on the accuracy of the title - since they use the keywords to identify relevant articles

Types of title that can be used for scientific papers

- **Indicative titles** indicate the subject matter of a paper but give no indication of any results obtained or conclusions drawn. e.g. *The effectiveness of bed nets in controlling mosquitoes at different seasons of the year.*
- **Informative titles** give an indication of results achieved and conclusions drawn as well as the subject matter of the paper. e.g. *Bed nets control mosquitoes most effectively when used in the rainy season.*

Types of title that can be used for scientific papers

- **Question-type titles:** This type of title obviously asks a question. e.g. *When are bed nets most effective when used to control mosquitoes?*
- **Main-subtitle (series) type:** This approach is not liked by editors of scientific journals because if they accept the first paper they will be duty bound to accept sequels. e.g. *The effect of bed nets on mosquitoes: 1.Their effectiveness when used only in the rainy season.*

Authors Listing

- ONLY include those who have made an intellectual contribution to the research
- OR those who will publicly defend the data and conclusions, and who have approved the final version
- Order of the names of the authors can vary from discipline to discipline
  - In some fields, the corresponding author's name appears first

Abstract

- **Briefly** summarize (often 150 words) - the problem, the method, the results, and the conclusions so that the reader can decide whether or not to read the whole article
- Together, the title and the abstract should stand on their own
- Many authors write the abstract last so that it accurately reflects the content of the paper

A brief synopsis of writing an abstract

- It’s a mini paper:
  - Introduction (usually 1-2 sentences)
  - Methods (often longest part)
  - Results
  - Discussion is limited to concluding statement
- Like a paper, requires many drafts, most oriented to presenting argument concisely

Introduction

- Clearly state the:
    1. Problem being investigated
    2. Background that explains the problem
    3. Reasons for conducting the research
- Summarize relevant research to provide context
- State how your work differs from published work

Introduction

- Identify the questions you are answering
- Explain what other findings, if any, you are challenging or extending
- Briefly describe the experiment, hypothesis(es), research question(s); general experimental design or method

Methods

- Provide the reader enough details so they can understand and replicate your research
- Explain how you studied the problem, identify the procedures you followed, and order these chronologically where possible

Methods

- Explain new methodology in detail; otherwise name the method and cite the previously published work
- Be precise in describing measurements and include errors of measurement or research design limits

Results

- Objectively present your findings, and explain what was found
- Show that your new results are contributing to the body of scientific knowledge

Results

- Follow a logical sequence based on the tables and figures presenting the findings to answer the question or hypothesis
- Figures should have a brief description (a legend), providing the reader sufficient information to know how the data were produced

Captions should not merely name a table or figure, they should explain how to read it.

- A caption (**figure or table heading**) should contain sufficient information so that a reader can understand a table or figure, in most cases, without reference to the text. Very simple tables and figures may require only a title for clarity, and exceptionally complex ones may require reference to the text for explanation.
- Do not leave caption writing to the end of the project; write captions when you organize your Results section and it will help you write the text.

Discussion/Conclusion

- Describe what your results mean in context of what was already known about the subject
- Indicate how the results relate to expectations and to the literature previously cited
- Explain how the research has moved the body of scientific knowledge forward

Discussion/Conclusion

- Do not extend your conclusions beyond what is directly supported by your results - avoid undue speculation
- Outline the next steps for further study

References

- Whenever you draw upon previously published work, you **must** acknowledge the source
- Any information not from your experiment and not “common knowledge” should be recognized by a citation

References

- How references are presented varies considerably - refer to notes for authors for the specific journal
- Avoid references that are difficult to find
- Avoid listing related references that were not important to the study

Harvard Reference Style

Uses the author's name and date of publication in the body of the text, and the bibliography is given alphabetically by author

- Adams, A.B. (1983a) Article title: subtitle. Journal Title 46 (Suppl. 2), 617-619
- Adams, A.B. (1983b) Book Title. Publisher, New York.
- Bennett, W.P., Hoskins, M.A., Brady, F.P. et al. (1993) Article title. Journal Title 334 , 31-35.

Vancouver Reference Style

Uses a number series to indicate references; bibliographies list these in numerical order as they appear in the text

1. Adams, A.B. (1983) Article title: subtitle. Journal Title 46 (Suppl. 2), 617-619.

2. Lessells, D.E. (1989) Chapter title. In: Arnold, J.R. & Davies, G.H.B. (eds.) Book Title , 3rd edn. Blackwell Scientific Publications, Oxford, pp. 32-68.

3. Bennett, W.P., Hoskins, M.A., Brady, F.P. et al. (1993) Article title. Journal Title 334 , 31-35.

Summaries/Examples of Styles

- International Committee of Medical Journal Editors Uniform Requirements for Manuscripts Submitted to Biomedical Journals: Sample References

  http://www.nlm.nih.gov/bsd/uniform_requirements.html

- How to Cite References/Vancouver Style, Murdoch University, Australia

  http://wwwlib.murdoch.edu.au/find/citation/vancouver.html

Getting Tense!
PAST and PRESENT

When quoting *previously published work*, refer to it in *present tense* (e.g. penicillin treats strep throat)

When describing your *own study*, refer to work in *past tense* (e.g. we tested a new antibiotic for strep throat)

Getting Tense!
PAST and PRESENT

or

What you, or others, did in the past should be stated in the past tense (e.g. data were collected....").

Events or objects that continue to happen or exist can be described in the present tense (e.g., "in this paper, I examine..... The data reject the hypothesis that.....).

Whatever tense you choose, be consistent.

Getting Tense!
PAST and PRESENT

Be careful in using "might," "may," and "would" (as in "this might indicate that..."). They are frequently used as ways of weaseling out of making a clear statement.

Pop Quiz: The good scientific paper ...

A. Is focused on a specific question(s).

B. Covers a broad spectrum of disease or methodologic questions

➢ Less is More.

Pop Quiz: In a good scientific paper ...

A: Abstract and tables and figures are understandable without reading whole paper.

B. Abstract and tables and figures are understandable only with reading whole paper.

Pop Quiz: In a good scientific paper ...

A: Writing is in passive voice (e.g. it was found that…)

B. Writing is in active voice (we found that…)

C. Writing mixes active and passive voice

Pop Quiz: In a good scientific paper ...

A: A term defined in the methods section is used again and again (a rose, a rose, a rose)

B. Various synonyms for a term are used to prevent reader boredom. (a rose, a flower with a thorny stem, a fragrant flower)

- Define a term and use it consistently. Otherwise, you'll confuse the reader.

Pop Quiz: In a good scientific paper ...

A: Writing is flowery

B. Writing is concise

- Generally, the shorter, the better

Proofread before Submitting

"Good writing is rewriting," and you should make a serious effort at editing, rewriting, and fine-tuning before you give the manuscript to anyone else to read.

If you need to put a piece of writing away for a few days before you can approach it dispassionately enough to rework it.

Do not use more words where fewer will do

- Do not use long words where short ones will do.

- For example:
  “utilization” vs. “ use ”
  “ in order to ” vs. “ to ”

- Do not use special words to make your writing seem more technical, scientific, or academic when the message is more clearly presented otherwise.

Language Issues – Summary/Conclusion

- Verbs has to agree with their subjects.
- Kill all exclamation points !!!
- Use words correctly, irregardless how others use them.
- Understatement is always the absolutely best way to put forth earth-shaking ideas.
- Eliminate commas, that are, not necessary.

Word Usage in Scientific Writing

The following list includes some of the troublesome words, terms, and expressions most frequently found in Experiment Station journal paper and bulletin manuscripts. In reporting and recording research, try to be as accurate and precise in describing it as in doing it. Avoid the ambiguous and "faddish". For the benefit of international readers, especially, use standard words in their established meanings.

Above ("the above method", "mentioned above", etc.) -- Often, you are referring to something preceding, but not necessarily *above*; a loose reference, convenient for writers, but not for readers. Be specific. You know exactly what and where, but your readers have to search.

Affect, effect -- Affect is a verb and means to *influence.* Effect, as a verb, means to *bring about* ; as a noun, effect means *result.*

All of, both of -- Just "all" or "both" will serve in most instances.

Alternate, alternative -- Be sure which you mean.

And (to begin a sentence) -- You have been told not to do this in grade school. But teacher's purpose was to keep you from using fragmentary sentences; either "and" or "but" may be used to begin complete sentences. And both are useful transitional words between related or contrasting statements.

Apparently (apparent) -- means *obviously, clearly, plainly evident*, but also means *seemingly* or *ostensibly* as well as *observably.* You know the meaning that you intend, but readers may not. Ambiguity results. Use *obvious(ly), clear(ly), seeming(ly), evident(ly), observable* or *observably,* etc., as needed to remove doubt.

At the present time, at this point in time -- Say "at present" or "now" if necessary at all.

Below -- See comment about *above.*

But (to begin a sentence) -- see "And" and "However".

By means of -- Most often, just "by" will serve and save words.

Case -- Can be ambiguous, misleading, or ludicrous because of different connotations; e.g., “In the case of Scotch whiskey, ...” *Case* also is a frequent offender in padded, drawn-out sentences. For “in this case,” try “in this instance.”

Commas and punctuation -- The trend is toward less punctuation (particularly fewer commas), but that demands careful writing, without misplaced or dangling elements. Do **not** omit commas before the conjunctions in compound sentences. Most journals, but not all, use final commas before “and” or “or” in series, check the journal.

Compare with, compare to -- Compare *with* means to examine differences and similarities; compare *to* means to represent as similar. One may conclude that the music of Brahms compares *to* that of Beethoven, but to do that, one must first compare the music of Brahms *with* that of Beethoven.

Correlated with, related to -- Although things may be *related to* one another, things are *correlated with* one another.

Different from, differ with -- Different from! Also, one thing *differs from* another, although you may *differ with* your colleagues.

Due to -- Make sure that you don't mean *because of.* Due is an adjective modifier and must be directly related to a noun, **not** to a concept or series of ideas gleaned from the rest of a statement.

During the course of, in the course of -- Just use "during" or "in.“

Either....or, neither...nor -- Apply to no more than two items or categories. Similarly, *former* and *latter* refer only to the first and second of only two items or categories.

Etc. -- Use at least two items or illustrations before "and so forth" or "etc.“

Experience(d) -- To experience something is sensory; inanimate, unsensing things (lakes, soils, enzymes, streambeds, farm fields, etc.) do not experience anything.

- **High(er), low(er)** -- Much too often used, frequently ambiguously or imprecisely, for other words such as *greater, lesser, larger, smaller, more, fewer*; e.g., “Occurrences of higher concentrations were lower at higher levels of effluent outflow.” One interpretation is that greater concentrations were fewer or less frequent as effluent volume(s) increased, but others also are possible.

However -- Place it more often within a sentence or major element rather than at the beginning or end. "But" serves better at the beginning.

Hyphening of compound or unit modifiers -- Often needed to clarify what is modifying what; e.g., a small-grain harvest (harvest of small grain) is different from a small grain harvest (small harvest of *all* grain), *and a man eating fish is very different from a man-eating fish!*

In order to -- For brevity, just use "to"; the full phrase may be used, however, [in order] to achieve useless padding.

Irregardless -- No, *regardless*. But *irrespective* might do.

It should be mentioned, noted, pointed out, emphasized, etc. -- Such preambles often add nothing but words. Just go ahead and say what is to be said.

It was found, determined, decided, felt, etc. -- Are you being evasive? Why not put it frankly and directly? (And how about that subjective "felt"?)

Less(er), few(er) -- "Less" refers to quantity; "fewer" to number.

Myself -- Not a substitute for me. "This paper has been reviewed by Dr. Smith and myself" and "The report enclosed was prepared by Dr. Jones and myself" are incorrect; *me* would have been correct in all instances. Some **correct** uses of *myself*: I found the error myself. I myself saw it happen. I am not myself today. I cannot convince myself.

Partially, partly -- Compare the meanings (see also *impartially*). *Partly* is the better, simpler, and more precise word when partly is meant.

Percent, percentage -- Not the same; use percent only with a number.

Predominate, predominant -- *Predominate* is a verb. *Predominant* is the adjective; as an adverb, *predominantly* (not "predominately").

Prefixes -- (mid, non, pre, pro, re, semi, un, etc.) -- Usually not hyphened in U.S. usage except before a proper name (pro-Iowa) or numerals (mid-60s) or when lack of a hyphen makes a word ambiguous or awkward. *Preengineered* is better hyphened as *pre-engineered*, one of the few exceptions.

Principle, principal -- They're different; make sure which you mean.

Prior to, previous to -- Use *before*, *preceding*, or *ahead of*. There are *prior* and *subsequent* events that occur before or after something else, but *prior to* is the same kind of atrocious use that attempts to substitute “subsequent to” for “after”.

Proven -- Although a *proven* adjective, stick to *proved* for the past participle. “A *proven* guilty person must first have been *proved* guilty in court.”

Provided, providing -- *Provided* (usually followed by "that") is the conjunction; *providing* is the participle.

Reason why -- Omit *why* if reason is used as a noun. The reason is...; or, the reason is that... (i.e., the reason **is** the why).

Since -- has a time connotation; use “because” or “ inasmuch as ” when either is the intended meaning.

Small in size, rectangular in shape, blue in color, tenuous in nature, etc. -- Redundant.

That and which -- Two words that can help, when needed, to make intended meanings and relationships unmistakable. If the clause can be omitted without leaving the modified noun incomplete, use which and enclose the clause within commas or parentheses; otherwise, use *that*. Example: "The lawn mower, *which is* broken, is in the garage." But, "The lawn mower *that is* broken is in the garage; so is the lawn mower *that* works."

To be -- Frequently unnecessary. “The differences were [found] [to be] significant.”

Varying -- Be careful to distinguish from *various* or *differing*. In saying that you used varying amounts or varying conditions, you are implying **individually changing** amounts or conditions rather than a selection of various or different ones.

Where -- Use when you mean *where*, but not for "in which," "for which," etc.

Which is, that were, who are, etc. -- Often not needed. For "the site, which is located near Ames," try "the site, located near Ames" or "the site, near Ames." Rephrasing sometimes can help. Instead of "a survey, which was conducted in 1974" or "a survey conducted in 1974," try "a 1974 survey."

Think about the structure of paragraphs

A paragraph should begin with a topic sentence that sets the stage clearly for what will follow. Make topic sentences short and direct. Build the paragraph from the ideas introduced in your topic sentence and make the flow of individual sentences follow a logical sequence.

Technicalities——Typesetting

- **What You See Is What You Get**
  - Microsoft Word - versatile commercial document composing tool. Nevertheless it does have 1 very important inherent drawback: equations quality.
  - OpenOffice.org - ...

- **What You See Is What You Mean**
  - LaTeX - a macro package around TeX, which is a typesetting system capable of providing truly high-quality material of any kind.

Reference management software

Reference management software, citation management software or personal bibliographic management software is software for authors to use for recording and utilising bibliographic citations (references). Once a citation has been recorded, it can be used time and again in generating bibliographies, such as lists of references in articles.

Examples: Endnote, BibTeX , Mendeley;

Internet source for literature: ISI/Web of Science

Check before submission that you:

- Reconsidered the appropriateness of your title and abstract and your index terms (if any).
- Numbered the text pages consecutively, beginning with the first or title page.
- Numbered your tables (typed separately from the text, not more than one on a page) consecutively in the order in which you want them to appear.

- Made certain that illustrations are numbered consecutively in the order in which you want them to appear in your article, that each of them is referred to at least once in the text, and that each reference is to the appropriate illustration.

- Read the title and headings of each table objectively to determine whether the table can be understood without reference to the text
- Searched the text for references to tables to make certain that each table is referred to and that each of the references is to the appropriate table.

- Indicated by a marginal note a place for each table.
- Examined your text, tables and legends to make certain that each reference cited is accurately represented in the reference list.
- Examined your reference list to make certain that each work listed there is accurately referred to in the text, tables or legends.
- Examined each item in the bibliography section for accuracy of dates, wording, spelling and other details.

- Reviewed the special requirements of the journal to which you are submitting your manuscript and made certain that you have met them.
- Carefully read your final typescript at least twice, the second time preferably on a different day.

- In case of submission by mail: prepared as many copies of your text, tables and illustrations as are required.

or

- In case of online submission: prepared the files according to the instructions for authors, and provided the software you have used.

- Kept for your files a complete copy of your manuscript and accompanying material.
- Enclosed copies of releases for material requiring releases.

Note:

nowadays, tables and figures are usually inserted in the (electronic) manuscript at appropriate positions, with captions included.

Refer to “author instructions“ in case!

Responding to the editor:

- **Acceptance without revision**

  You need take no further action untile the proofs reach you, except prehaps write a note thanking the editor.

Responding to the editor:

- **Minor revisions requested (“accepted”)**
  - ➢Consider the suggestions carefully, and if you agree that they will improve the paper, modify or rewrite sentences or sections as necessary.
  - ➢Retype any heavily corrected pages before you return the paper to the editor, but enclose the original corrected paper as well as the retyped copies.
  - ➢In your covering letter sent with the revised version, thank the editor and referees for their help and enclose a list of the substantial changes made in response to their suggestions; if you have rejected one or more of the recommendations, explain why.

Major revisions requested(“further consideration”)

You will have to think hard if the effort is worth while. You may eventually decide that the paper is better as it is, and proceed to try another editor (another journal) in the hope that he will agree with you.

Rejection

- If the editor says the article is too specialized or outside the scope of the journal, your best course is to send it to another journal, first modifying the style to comply with the instructions of that journal.

- If the article is rejected because it is said to be too long and in need of changes, consider shortening and modifying it according to the criticism – and then submit it to a different journal (If the editor had wanted to see a shorter version he would have offered to reconsider it after revision!)

Rejection

- If the editor thinks the findings reported are unsound or that the evidence is incomplete, put the paper aside until you have obtained more and better information, unless you are sure that the editor and his advisers are wrong.

- Consider contesting the decision only if you honestly think, after considerable reflection and at least one night‘s sleep, that the editor and referees have made a superficial or wrong judgement. In this case write a polite letter explaining as briefly as possible why you think the editor should reconsider his decision.

Getting the Reviews of Your Paper

“The reviewer is always right.” (whether they are or not!)

Don’t respond quickly. Digest reviews.

Summary: Steps in writing a paper

- Assess your work: decide what, when and where to publish. Refrain from duplicate publication, and define your purpose in publishing.
- Obtain and read the Instructions to Authors of the journal chosen
- Decide who the authors will be
- Draft a working title and abstract
- Decide on the basic form of the paper

Steps in writing a paper - continued

- Collect the material under the major headings chosen
- Design tables, including their titles and footnotes; design or select illustrations and write titles and legends for them
- Write for permission to reproduce any previously published tables, illustrations or other material that will be used
- Write a topic outline and perhaps a sentence outline
- Write, type or dictate a preliminary draft of the text quickly.

Steps in writing a paper - continued

- Check completeness of the references assembled
- Put the manuscript or typescript away for a few days
- Re-examine the structure of the paper
- Check the illustrations and tables and make the final versions
- Re-read the references you cite and check your own accuracy in citing them; check for consistency, and reduce the number of abbreviations and footnotes

Steps in writing a paper - continued

- (Re)type the paper (= first draft)
- Correct the grammar and polish the style
- Type several copies of the corrected paper (= second draft)
- Ask for criticism from co-authors and friends
- Make any necessary alterations

Steps in writing a paper - continued

- Compose a now title and abstract suitable for information retrieval, list the index terms and assemble the manuscript
- Compile the reference list, cross-check references against the text, and ensure that all bibliographical details are correct
- Retype (= penultimate version) and check typescript
- Obtain a final critical review from a senior colleague
- Make any final corrections (final version)

Steps in writing a paper - continued

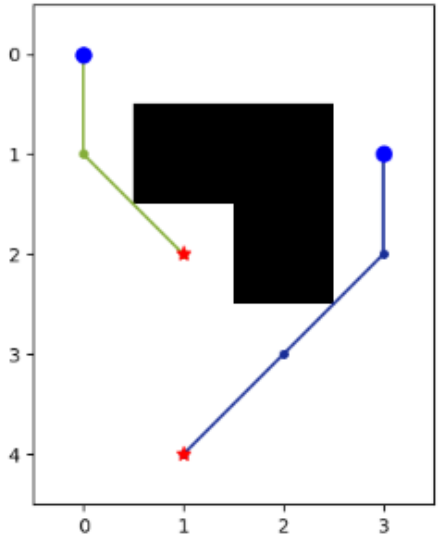
- Write a covering letter to the editor, enclosing copies of letters giving you permission to reproduce any previously published material or to cite unpublished work
- Check that all parts of the paper are present, and post as many copies as specified to the editor
- If the editor returns the paper, revise it as necessary, send it elsewhere, or abandon it
- Correct the proofs

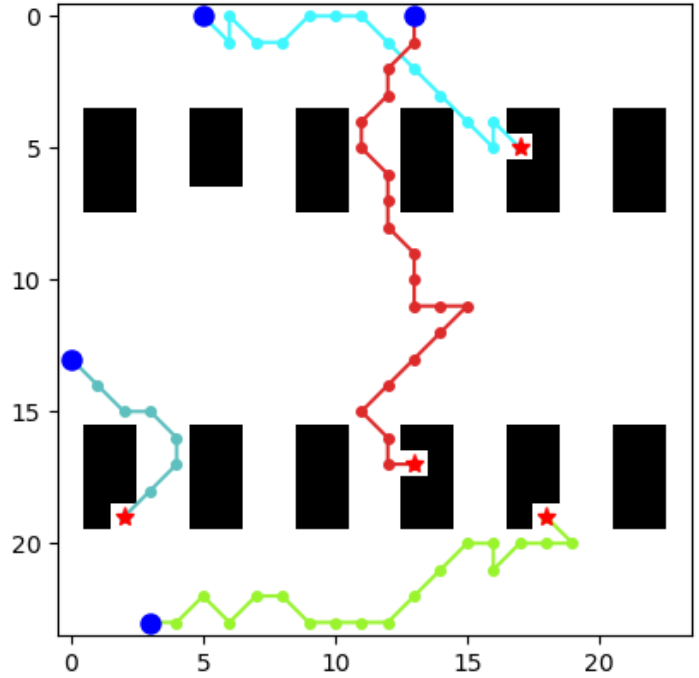
Assignment

Deadline:2021.06.27

Assignment

1. Complete the code “Multi-agent path finding based on ACO”





- *Specially, Add detailed comments to your code.*

Assignment

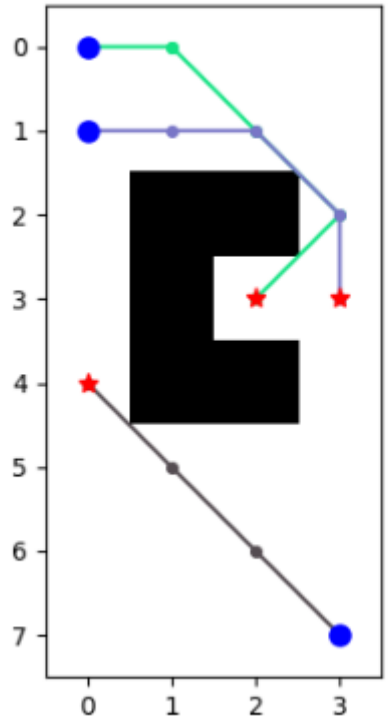
3. Optimize ACO

Such as Improved：

- Heuristic function
- Pheromone update mode
- Evaporation of trail （ρ）
- Initial pheromone

Assignment

2. Resolve conflict



Path[1]: [[(0, 0), (0, 1), (1, 2), (2, 3), (3, 2)],
Path[2]: [(1, 0), (1, 1), (1, 2), (2, 3), (3, 3)],
Path[3]: [(7, 3), (6, 2), (5, 1), (4, 0)]]

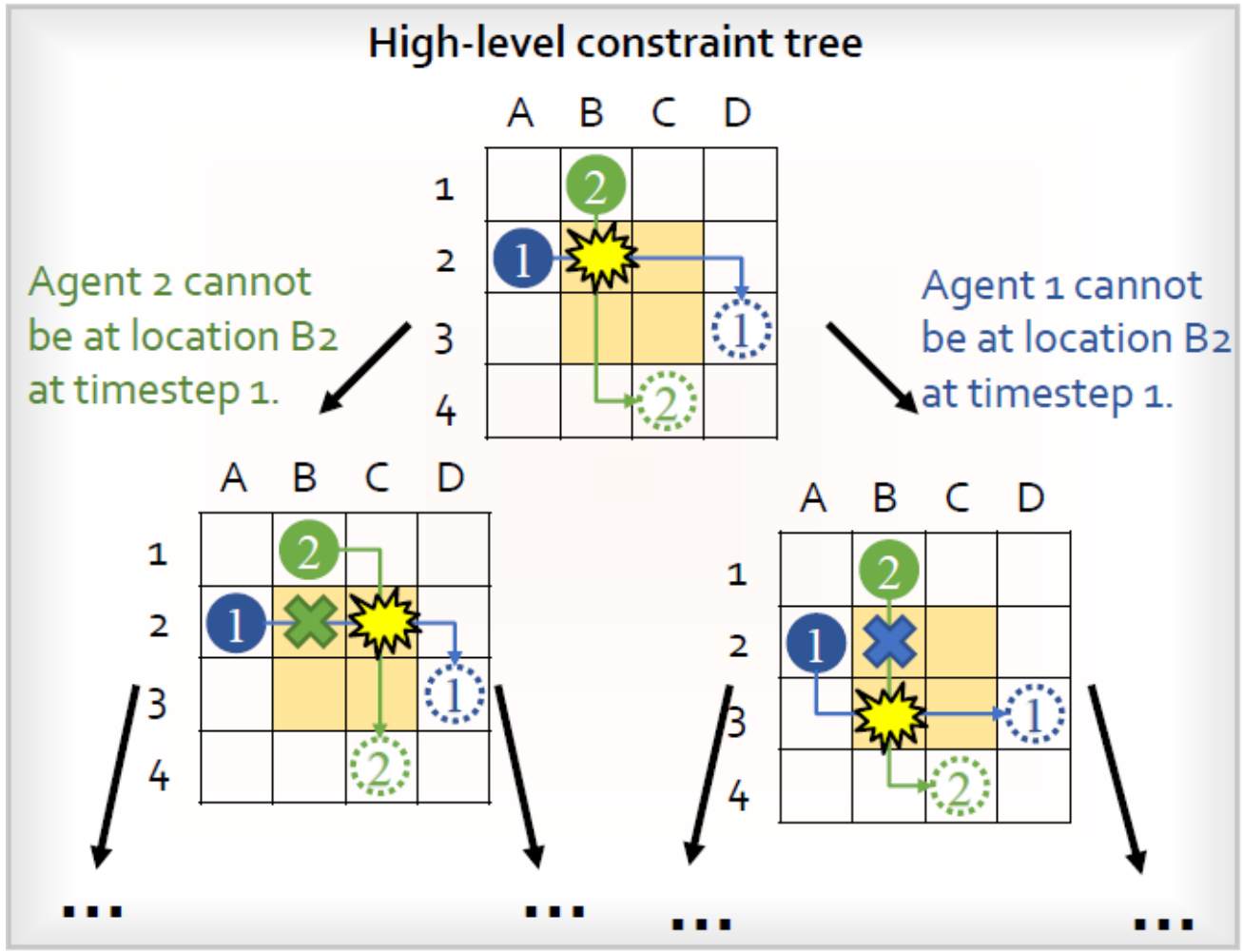
- *Only focus on vertex conflict*

Assignment

2. Resolve conflict

Example:

- The Increasing Cost Tree Search
- Conflict based search



- Sharon, G., Stern, R., Felner, A., Sturtevant, N.R.: Conflict-based search for optimal multi-agent pathfinding. Artif. Intell. 219, 40–66 (2015)
- 33. Sharon, G., Stern, R., Goldenberg, M., Felner, A.: The increasing cost tree search for optimal multi-agent pathfinding. Artif. Intell. 195, 470–495 (2013)

Write a Scientific Paper

- The structure of the paper is complete (Title, author information, abstract, key words, introduction, body, conclusion, references within 5 years and so on)
- The paper should be 4-6 pages long, no less than 4 pages.

Template:

- Obstacle Avoidance in Collective Robotic Search Using Particle Swarm Optimization

- Lisa L. ,Ganesh K..Obstacle Avoidance in Collective Robotic Search Using Particle Swarm Optimization. Swarm Intelligence.2006