Competitive Programming
Lecture 14 (Last Lecture! 🙁😎)

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Monday, May 1, 2023

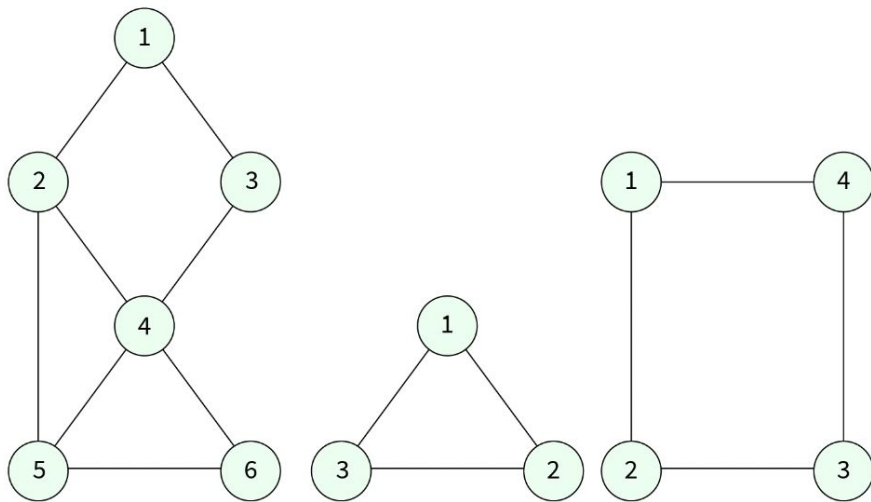# Now, let's dive right into more Graphs!

Part I: Graphs (con't)

1. Bi-connected Component
2. Dijkstra
3. 0-1 BFS
4. Floyd-Warshall

Part II: Q & A

Part III: Looking Ahead

1. Bi-connected Component

- A connected subgraph that cannot be broken into disconnected pieces by deleting any single node (and its incident links)

1. Bi-connected Component: Problem [CF 2200]

- https://codeforces.com/problemset/problem/97/E

1. Bi-connected Component: Solution [CF 2200]

- https://codeforces.com/blog/entry/59147

1. Bi-connected Component: Model Code [CF 2200]

- https://codeforces.com/contest/97/submission/90791006

1. Bi-connected Component: Reference

- https://usaco.guide/adv/BCC-2CC?lang=cpp

2. Dijkstra's: Problem [CF 1900]

- https://codeforces.com/problemset/problem/20/C

2. Dijkstra's: Solution [CF 1900]

- direct application of Dijkstra!

2. Dijkstra's: Model Code [CF 1900]

- https://codeforces.com/contest/20/submission/15760652

2. Dijkstra's: Reference

- https://cp-algorithms.com/graph/dijkstra.html

3. 0-1 BFS

- Special Case: **A graph with edge weights 0 or 1.**
- You can use a modified BFS with **deque**!

3. 0-1 BFS

```cpp
vector<int> d(n, INF); d[s] = 0;
deque<int> q; q.push_front(s);
while (!q.empty()) {
  int v = q.front(); q.pop_front();
  for (auto edge : adj[v]) {
    int u = edge.first, w = edge.second;
    if (d[v] + w < d[u]) {
      d[u] = d[v] + w;
      if (w == 1) q.push_back(u);
      else q.push_front(u);
    }
  }
}
```

3. 0-1 BFS: Problem [CF 1800]

- https://codeforces.com/contest/1063/problem/B

3. 0-1 BFS: Solution [CF 1800]

- https://codeforces.com/blog/entry/62455

3. 0-1 BFS: Model Code [CF 1800]

- https://codeforces.com/contest/1063/submission/80818679

3. 0-1 BFS: Reference

- https://cp-algorithms.com/graph/01_bfs.html

4. Floyd-Warshall

- **All-Pairs Shortest Paths (APSP)**
  - A directed or an undirected weighted graph G with n vertices.
  - Find the length of the shortest path d_{ij} between each pair of vertices i and j.

```
for (int k = 0; k < n; k++)
  for (int i = 0; i < n; i++)
    for (int j = 0; j < n; j++)
      d[i][j] = min(d[i][j], d[i][k] + d[k][j]);
```

4. Floyd-Warshall: Problem [CF 1700]

- https://codeforces.com/problemset/problem/295/B

4. Floyd-Warshall: Solution [CF 1700]

- https://codeforces.com/blog/entry/7329

4. Floyd-Warshall: Model Code [CF 1700]

- https://codeforces.com/contest/295/submission/15988207

4. Floyd-Warshall: Reference

- https://cp-algorithms.com/graph/all-pair-shortest-path-floyd-warshall.html

BREAK #1

Questions and Answers

- A lot of questions are submitted:
    - **44** students submitted;
    - Some students submitted **100** questions;
- I selected **40** questions, more or less at random
- I will answer others in Google document and share with you at some point!
- Thanks for submitting your questions!

Questions and Answers #1 / 40

- What is the number one tip you would give to graduating seniors that still want to stay in the competitive programming scene after graduation.
  - **Volunteer, volunteer, volunteer!**
  - **ICPC Internship!**

Questions and Answers #2 / 40

- Will tournaments/zealots continue throughout the summer?
  - **Absolutely! In fact, I plan on never turning it off as much as my bandwidth allows!**

- Can we contact you during summer using the website for arranging meeting?
  - **Please use Calendly and of course!**

Questions and Answers #3 / 40

- Can we take the the same course next semester and still get credit?
  - **Yes! We already got an approval from the department.**

Questions and Answers #4 / 40

- What would you change about the course for next year?
  - **Quite a few, but after listening carefully to your feedback.**
  - **I will share lessons learned momentarily.**

Questions and Answers #5 / 40

- How does this course compare to the Tech Interview Prep course taught in the fall?
  - **CP focuses on ICPC and harder problems through CodeForces;**
  - **Tech Interview Prep focuses on interviews through LeetCode;**

Questions and Answers #6 / 40

- What do you think about hacking for a contest to make people's solutions fail? Have you ever done it?
  - **It's a great way to spot mistakes.**
  - **Absolutely, I've done it many times!**

Questions and Answers #7 / 40

- Any advice to graduate students who are going to start their career soon?
    - **Cliché, but be passionate and inquisitive!**
    - **Be ambitious, but not overly!**

Questions and Answers #8 / 40

- How can we stay motivated and overcome challenges in career?
  - **Do not feel complacent: someone is always working!**
  - **Challenge yourself to stay ambitious!**

Questions and Answers #9 / 40

- How were you introduced to competitive programming?
  - **In October 3 2009, I happened to be in a computer cluster where a local contest in my university was held; I participated by accident and placed the dead last with 13 compilation errors since I did not know how to program (or how to even use a terminal).**

37	*Yongwhan Lim*		(-1)				(-13)				0	0

  - **I spent quite some time on training and on October 8, 2011, I came 9th.**

9	*Yongwhan Lim*	41+20	57	(-2)				100		3	218

  - **Then, in October 2012, I came 4th (but, missed the top team).**

- How much time did you spend practicing each week?
  - **Now, maybe at most 30 minutes a day.**
  - **At the peak, 24 hours a day.**
  - **One summer leading to the local, I had ~20 hours a day.**

- What are your tips on staying motivated?
  - **Have an ambitious, yet achievable goal.**

Questions and Answers #12 / 40

- How did competitive programming help your career?
  - **It got me an industry job, through referral and practice.**
  - **I solved 3785 problems as of today in CodeForces; I want to solve more!**

Questions and Answers #13 / 40

- What classes did you take that were most helpful for competitive programming and your career?
  - **I do not find a coursework useful.**

Questions and Answers #14 / 40

- What are your favorite kinds of problems?
  - **The one that allows me to think a lot and is barely solvable;**
  - **Multi-steps with multiple solutions;**

Questions and Answers #15 / 40

- Do you still practice competitive programming/interview prep even if you have a job?
    - **Yes, absolutely;**
    - **I find problem-solving interesting;**

Questions and Answers #16 / 40

- How do you decide when to move on from a job/company?
  - **When you are not learning as much as you used to;**
  - **Every 3 ~ 5 years;**

Questions and Answers #17 / 40

- What is your favorite thing about teaching this course?
    - **The fact that I get to teach a subject I love :)**
    - **Mentoring is fun!**

Questions and Answers #18 / 40

- Any advice for breaking into quantitative finance?
  - **Get to the ICPC World Finals :)**

Questions and Answers #19 / 40

- How do you recover from performing poorly on a contest?
  - **Get the fundamentals strong;**
  - **Do not GIVE UP!**

Questions and Answers #20 / 40

- Any advice on how to break through when you're very stuck on a program?
    - **Try to go through typical algorithm topics/paradigms and check if they are relevant; for easy enough question, this is often sufficient!**

- How do you make sure you memorize all the important algorithms?
  - **Go through cp-algorithms or usaco.guide;**

- What do you think are the most important CS classes to take to succeed in the SWE/Quant field?
  - **Taking course is orthogonal, in my opinion, to success in industry;**

Questions and Answers #23 / 40

- Do you think those who use Python over C++ in these contests are at a disadvantage?
  - **Of course! You should use C++ (or Java) if you want to be a serious competitive programmer, I think (for now..).**

Questions and Answers #24 / 40

- Should we do codeforces along with leetcode if our goal is to succeed in interviews? Or should we focus primarily on leetcode?
  - **LeetCode, if you would like a placement in tech industry;**
  - **CodeForces, if you would like a placement in quant/HFT space;**

Questions and Answers #25 / 40

- Will the material taught by Competitive Programming in next semester be the same as this semester?
    - **No, it will be absolutely different, in terms of topics and problems covered;**
    - **Also, the structure may have to get revamped;**

Questions and Answers #26 / 40

- How many mock interview could you usually be able to provide for one student in one semester?
  - **Once a day, everyday;**
- Can we do mock interview with you in the summer semester?
  - **Yes, absolutely!**
- Can we reach out to you for further help after finishing this class?
  - **Yes, absolutely!**
- How many hours do you usually sleep per day?
  - **I want to think ~8 hours per day, but my wife says ~3 hours...**

Questions and Answers #27 / 40

- What is your best advice for solving harder problems… struggling to make the jump from easy/medium problems
  - **Solve problems that are 300 +/- 100 ratings higher than your current true rating;**

- What made you interested in competitive programming in the first place?
  - **Easier to grade than math problems;**
  - **Grading math problems is quite tedious and time-consuming;**

Questions and Answers #28 / 40

- What do you think is the greatest value of doing algorithms competition? (aside from passing interviews)
  - **I never actually thought about using it for interview preparation;**
  - **It is useful, to some extent, in increasing your problem solving ability;**
  - **Entertainment value, over all else!**

Questions and Answers #29 / 40

- How do you think of a high performed student in this class beside of the score?
  - **As I mentioned in the first lecture and throughout, your score is a fluff at the end;**
  - **How much you learned matters the most, for you (and for me);**
  - **If you learned a lot, irrespective of the score, you are a high-performer.**

- How do you find time to do everything you do? (which seems like a huge number of time-consuming things)
  - **Prioritize;**
  - **Focus;**
  - **Control your bandwidth;**

- What were you involved in during your undergraduate years?
  - **Research: Math (Probability/Number Theory) + CS (Vision);**
  - **Putnam + ICPC;**

- Do you, or did you play video games?
  - **Yes, I used to play a lot!**
    - **League of Legends (Nocturne), Starcraft, Diablo series, ...**
    - **FFR, DDR, ...**
  - **Not now, except poker, which I do not do so much any longer!**

Questions and Answers #32 / 40

- What is the best way to keep improving if you are graduating, and not able to take this class anymore?
  - **Audit this course?**
  - **Become an intern for ICPC?**
  - **Volunteer for ICPC?**

Questions and Answers #33 / 40

- If we're doing our own practice over the summer, how do recommend doing so? Do you think that we should clone CodeForces contests so that we emulate a time limit, or just do miscellaneous problems?
    - **Do not study alone, unless you absolutely have to;**
    - **Use CodeForces groups and discords;**
- What kind of practice should we do during the summer, especially when it comes to getting prepared for October?
    - **Continue doing live contests in LeetCode/CodeForces/AtCoder;**
    - **Continue practice contests on Wednesdays, Saturdays, and Sundays;**

Questions and Answers #34 / 40

- Do you plan to host more lectures next semester like the one you did with your friends from Tesla? Or will more professional/networking focused lectures be more one off occasions?
  - **I did A/B testing and it seems like we want more;**
  - **So, we will do more!**

Questions and Answers #35 / 40

- So with the weekly contents and daily problem sets that you administer for us, it's easy to have a practice regimen. If we decide to start entering contests on our own (for example over the summer) on a team that we put together ourselves, how would you recommend finding good questions to practice on?
  - **No need to curate your own, since I will continue mine over the summer and after!**

Questions and Answers #36 / 40

- Have you tried a Costco Pizza?
  - **Yes, all time favorite, especially peperoni (and combination is now gone :()!**

Questions and Answers #37 / 40

- Have you ever procrastinated before?
  - **Yes, like everyday;**
  - **I only do things I enjoy doing; I discard the rest;**

Questions and Answers #38 / 40

- Do you have any pets?
  - **Yes, two maltipoos;**

Questions and Answers #39 / 40

- How do you see the competitive programming course transforming in the years to come?
  - **Ultimately, as a training ground for the ICPC world finalists, but as a deeper pipeline;**
  - **It will be complemented by the problem solving club;**
  - **Get people interested in problem solving (not grade/point so much);**

Questions and Answers #40 / 40

- Do you see yourself as a lifelong learner? Why?
  - **Yes, absolutely!**
  - **Frankly, I do not know much, so I need to learn more!**
  - **Clueless most of the time...**

- Are you satisfied with what you currently have in life?
  - **Never, ever, no;**
  - **Thankful, to God, for what I have;**
  - **But, I will be perpetually hungry;**

Lessons Learned as Instructor (through A/B testing)!

- Do pre-course assessment, to determine the fit.
- Pre-assign a team, instead of allowing students to choose, in day 0.
- Ask each student to sign a pledge for honor code in day 0.
- Provide an actual contest strategy in day 0.
- Provide a practice strategy in day 0.
- Update grade weekly, instead of once at the end.
- Make any assessment (practice or live contest) in-person, proctored.
- Make an attendance required for any lecture in-person.
- Make a course more interactive.
- Consider putting more guest lectures.

BREAK #2

LAST DATE TO SUBMIT YOUR WORK

11:59:59pm ET, WEDNESDAY, MAY 10, 2023

https://cp-ranking.netlify.app/

- If you find some issues/discrepancies, please reach out to **Akash** (akn2120@columbia.edu) and **cc me** (yongwhan.lim@columbia.edu) for visibility.

Honor Code: <u>NOT</u> citing sources (minor)

- As mentioned in first few lectures, you **<u>MUST</u>** cite your sources on each and every problem where you referenced an external solution, editorial, code snippets, etc.
  - You can cite it as simple as "// {reference 1}\n// {reference 2}..."
- **If you have at least one submission without citation**, please send me an email to yongwhan.lim@columbia.edu immediately so that you can avoid running into an honor code violation. The deadline is **Wednesday, May 3, 2023**.
- You will get a warning email from me if you did this.

Honor Code: using someone else's account (major)

- In under any circumstance, you are **<u>NOT allowed</u>** to use someone else's account to submit a solution on the account holder's behalf.
- This is a serious problem and will most likely have a serious consequence, even if it is done by accident.
- If your solutions were ever **skipped** in CodeForces, please reach out to <u>yongwhan.lim@columbia.edu</u> immediately to avoid getting an automatic F in the course.

Honor Code: paying someone to do the contest (serious)

- In under any circumstance, you are **<u>NOT allowed</u>** to pay someone to do the contest for you using your account.
- This is a serious problem (that may have a legal implication) and will most likely have a serious consequence, even if it is done by accident.
- If you did this, please reach out to yongwhan.lim@columbia.edu immediately to avoid getting an automatic F in the course in addition to getting into a legal trouble.

IF YOU WOULD LIKE TO KNOW YOUR GRADE %

- Send me an email at **yongwhan.lim@columbia.edu** to find out.
- Please **DO NOT** send me a meeting request just to find out your course grade.

- **Due to some people are going through the honor code situations, I can only release the grade in case-by-case basis at the moment.**

Exit Survey, for `15` Live Contest Points

- Fill out by **11:59pm ET, Wednesday, May 10**:

https://forms.gle/XZnrrGMjHXHz2gdW6

ICPC GNYR IT Volunteering, for 5 Live Contest Points

- Fill out by **11:59pm ET, Wednesday, May 10**:

   https://forms.gle/b7iA64oe443mmpKd8

T-SHIRT

- Fill out by **11:59pm ET, Friday, May 5**:

  https://forms.gle/pko6ZzMViHi1ALt39

PRACTICE MAKES PERFECT!

- Do as **many practice contests** as you can!
  - CodeForces **live contests**
  - ICPC **practice contests** on:
    - **ICPC GNYR**: **Wednesdays** from 7pm ET to 9:30pm ET
    - **Columbia ICPC**: **Saturdays** from 1pm ET to 6pm ET
    - **ICPC NA**: **Sundays** from 1pm ET to 6pm ET

DISCORD SERVERS

- Join the following discord servers, if you have not already!!!
  - **[ICPC CodeForces Zealots]** https://discord.gg/7bvMnMyF6G
  - [**GNYR ICPC Practice**] https://discord.gg/nb4f2brKdw
  - **[ICPC Training Warriors]** https://discord.gg/mAUGf3Zxx8

  - [Problem Solving Warriors] https://discord.gg/HEkTf9RhME
  - [Hedge Fund Warriors] https://discord.gg/4v2rUXyst9

SEAS FINAL COURSE EVALUATION

- Per **EVERY 5%** filling out SEAS Final Course Evaluation, you will get **ONE** extra live contest point.

FALL 2023 COURSES

- If you have **not** put yourself in the waitlist for Fall 2023 **Competitive Programming** or **Technical Interview Prep in C++** courses yet, but you would like to, **please do so!**

- Happy to serve you again! 🤩😎

Where do we go from here?

- This course is really for ICPC contest series preparations:
  - **November 2023: <mark>WORLD FINALS!</mark>**
    - **Columbia-fortcoders: (Kaiheng Dai; Kevin Yang; Neal Lai)**

- 2023-2024 Cycle:
  - **August/September 2023**: Columbia University Local Contest (CULC);
  - **October 29, 2023**: Greater New York Regional (GNYR), @Columbia;
  - TBD: North America Qualifier (NAQ);
  - TBD: North America Championship (NAC);

For further training...

- Train, train, train, BUT only go so much to **NOT** burnout. **IT IS REAL!**
- Register for **Universal Cup**: ask, if interested!
- **CSES**: https://cses.fi/problemset/
- **Kattis**: https://open.kattis.com/ with its companion:
  https://cpbook.net/methodstosolve?oj=kattis&topic=all&quality=all
- **USACO Guide:** https://usaco.guide/ (especially Platinum and Advanced)
- **CP Algorithm:** https://cp-algorithms.com/
  - String Processing; Graphs; Linear Algebra; Data Structures; ...

How to prepare for GNYR?

- **Read Terse Guide**: https://docs.google.com/document/d/1vIh0YQJwmzhigJDhRFTwKyA0eHP9a9-tKYaeEksfvrc/edit?usp=sharing

- **Use Calendly**: https://calendly.com/yongwhan/one-on-one

- **Request Regular 1:1 Meeting**: https://forms.gle/BZpEuJHM4oZh6BSv9

THANK YOU SO MUCH FOR SUCH A GREAT SEMESTER!!!

- **DO NOT give up**
- Whenever you feel **negative**, **reach out to me** through **Calendly**!
- **The sooner the better!!!**

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- Feel free to use yongwhan@yongwhan.io to stay in touch!!
- After all, the **North Star** is **a step closer**! *Let's get it*, folks! ✨✨ 🤩

REQUEST 1:1 Meeting, through Calendly

- Use calendly.com/yongwhan/one-on-one to request 1:1 meeting:
  - Mock Interview
  - Resume Critique
  - Career Planning
  - Practice Strategy
  - ...
- Always inspired by driven students like yourself!
- Since I'd feel honored/thrilled to talk to you, do not feel shy to sign up!!

CONTACT INFORMATION

- **Email**: <mark>**yongwhan@yongwhan.io**</mark>

- **Personal Website**: <mark>**https://www.yongwhan.io/**</mark>

- **LinkedIn Profile**: <mark>**https://www.linkedin.com/in/yongwhan/**</mark>
    - Feel free to send me a connection request!

THANK YOU