CS309

OBJECT-ORIENTED ANALYSIS AND DESIGN

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Who and Where Am I?

- Dr. Yuqun Zhang （张煜群）
- Research Interests: LLM-based Software Engineering, Software Analysis, Testing, and Security (Fuzz Testing, Taint Analysis, Software Component Analysis, etc.)
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- Office: Room 610, Engineering Building South
- Office Hours: 2-4pm, Wednesday, or appointment by email

A LITTLE SOMETHING ABOUT ME…

My Styles and Rules

- Casual
- Interaction
- Mutual Respect
- NO CHEATING!!!!!
  - You may work together in this class, as specified on each specific assignment. Do **NOT** use any resource without citation.

Instructor and Teaching Assistant

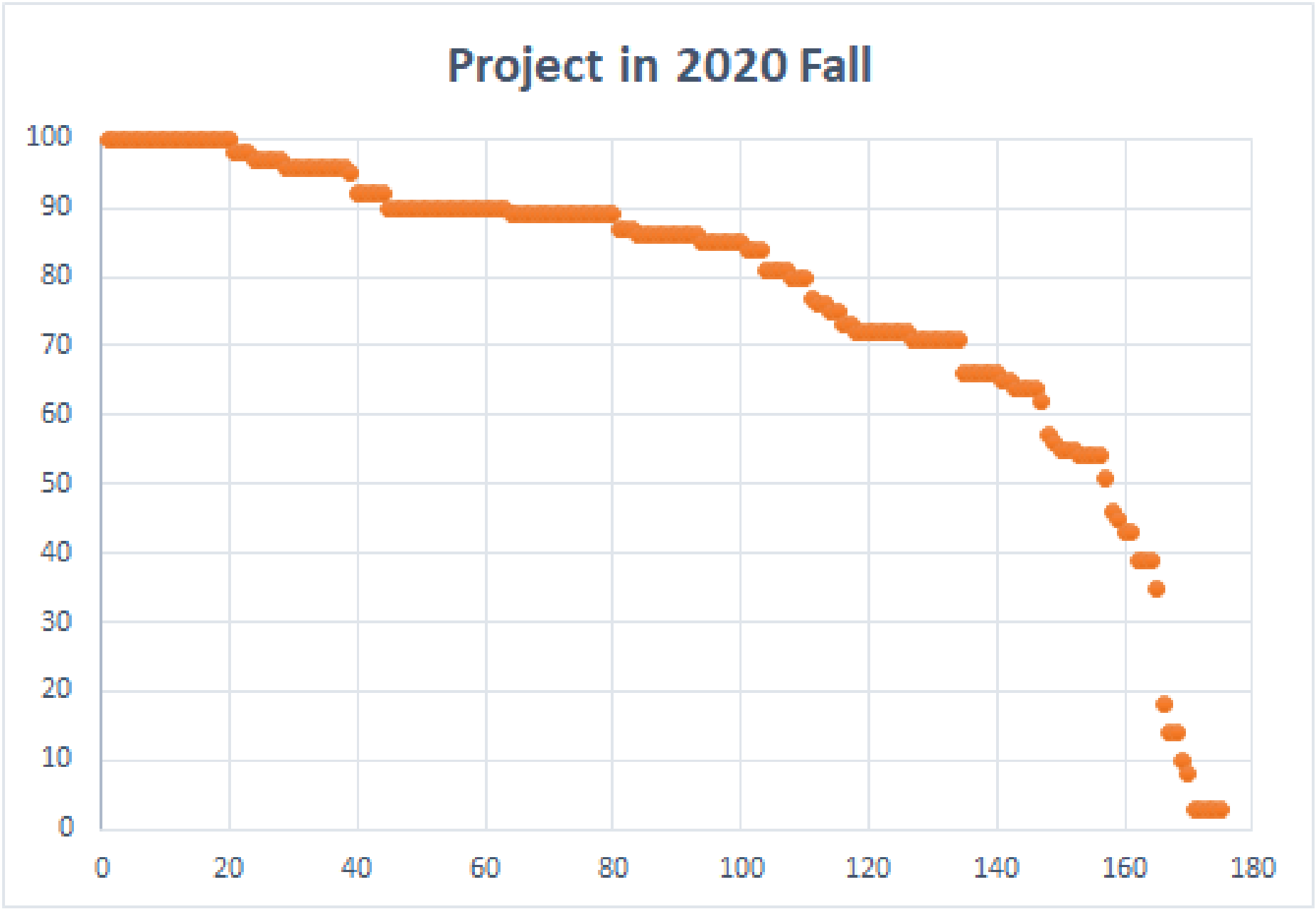
- Yueming Zhu (朱悦铭)
  - Email: zhuym@sustech.edu.cn
- Lei Tian (田蕾)
  - Email: tianl3@mail.sustech.edu.cn
- Yiwei Ren (任艺伟)
- Peiqi Yuan (原佩琦)
- Yajing Tan (谭雅静)
- Zerong Huang (黄增荣）
- Shaolin Huang (黄少霖)

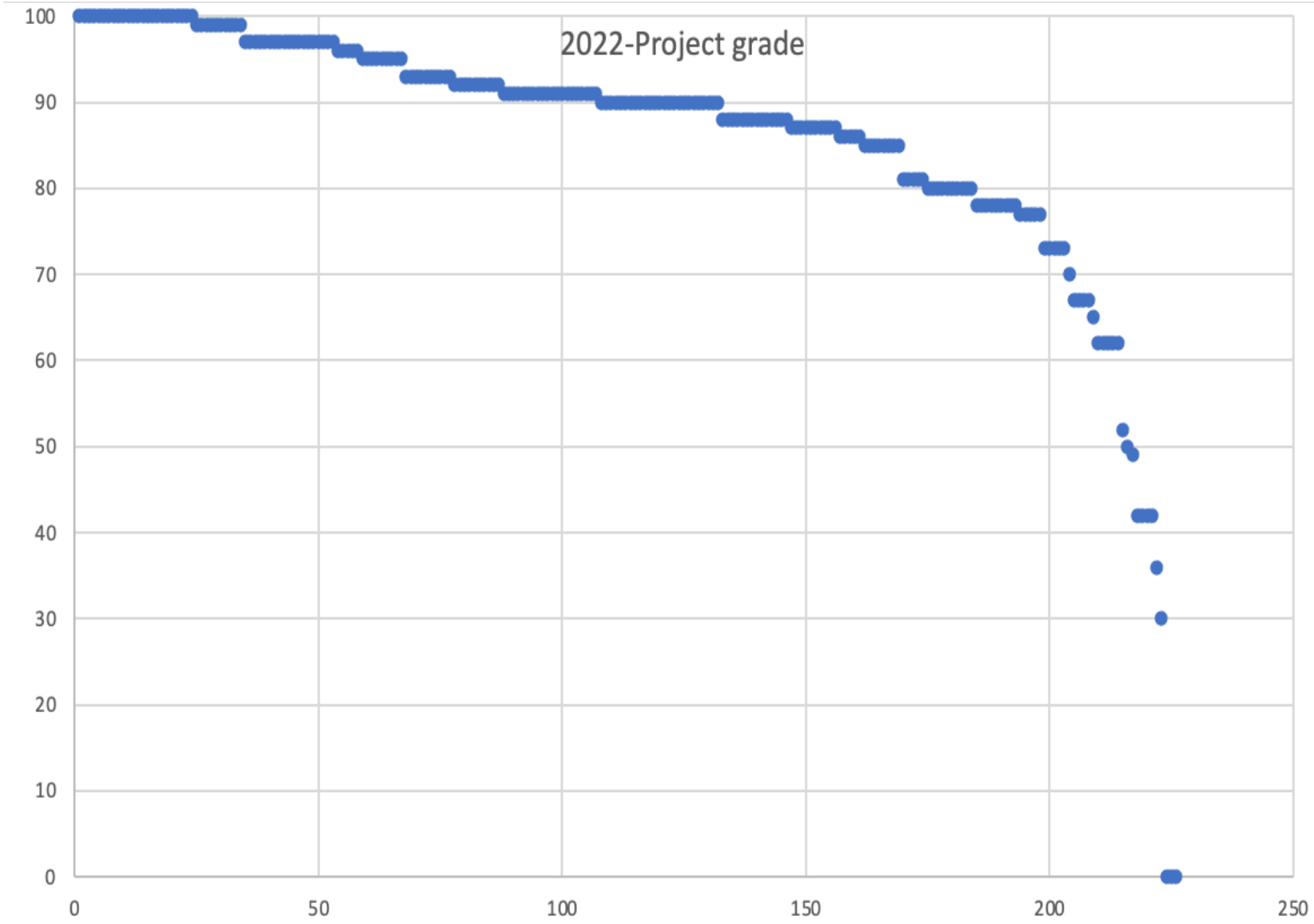
Textbooks

- Freeman et al., *Head First Design Patterns*
- *Martin Fowler, Refactoring*
- Block, *Effective Java*
- Zeller and Krinke, *Essential Open Source Toolset: Programming with Eclipse, JUnit, CVS, Bugzilla, Ant, Tcl/TX and More*
- McConnell, *Code Complete: A Practical Handbook of Software Construction*
- Pilone, *UML 2.0 Pocket Reference*

Evaluation and Grading

- Weekly Lab Tutorials– 25%
- Project – 35%
  - Web applications/Games
  - Group of 3 to 5 (before the end of next week)
    - Please be subject to the group size!!
  - 3 presentations (proposal, progress, final)
  - 1 written report
- Exams – 35%
  - Final:
    - What's on an exam? Anything from any aspect of class, including lab sections.
    - No hints (重点）
- In-Class Exercises/Attendance – 5%
  - Spontaneous (That means in general I do not call the roll. But I have my own moves  )


Project in 2020 Fall
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
160
180


2022-Project grade
100
90
80
70
60
50
40
30
20
10
0
0
50
100
150
200
250

You could say this is a “breathing” class (not a “水” class).

I just want you to be happy in this semester.

ALRIGHT, LET'S GET REAL

Expectations

- You're going to have to "own" your education in this class
  - I have a feeling this is going to be an awesome semester…
- But…
  - Expect that I may not be able to give you an immediate answer (I'm alright if my response to your question is "I don't know," so you're going to have to be alright with that, too)
  - I (or the TAs) WILL always try to help find you the answers you need in a timely fashion. Be patient.

Tips of Handling Problems

- Once you encounter problems (theory or practice), you are expected to
  - first, try your real best to solve them by yourself

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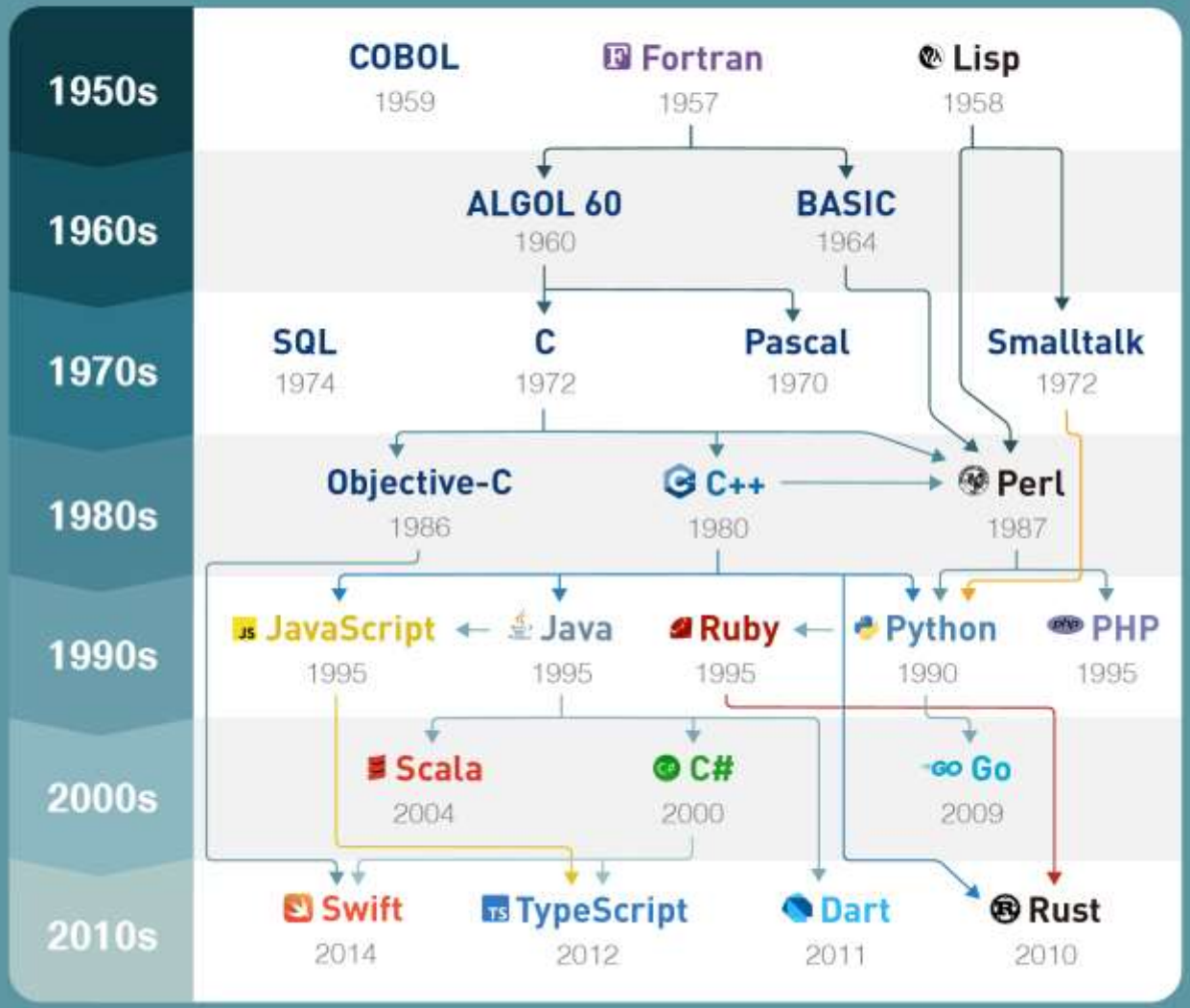
Tips of Handling Problems

- Once you encounter problems (theory or practice), you are expected to
  - first, try your real best to solve them by yourself
  - if not working, try to talk with your cohorts.
  - if not working, then ask us
- If we find that you are not paying effort by yourself, we would be reluctant to help you at later time.

TECKY ACADEMY

Timeline of Programming Languages



What You Would Learn

- Of course the object-oriented design and analysis
- Typically, you are going to learn something about
  - requirement engineering (UML)

UML Examples

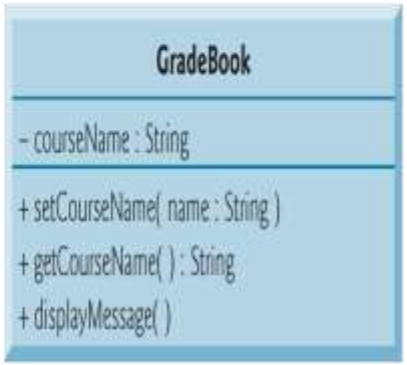


Fig. 7.3 | UML class diagram for class GradeBook.

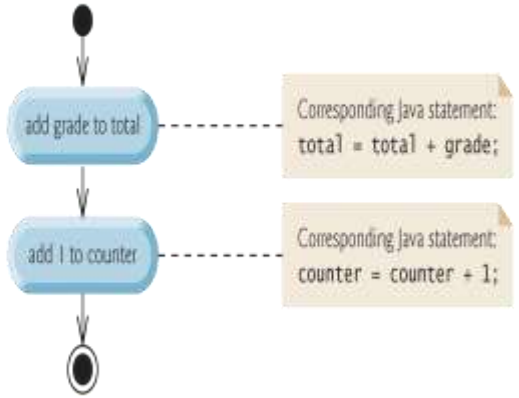


Fig. 3.1 | Sequence structure activity diagram.

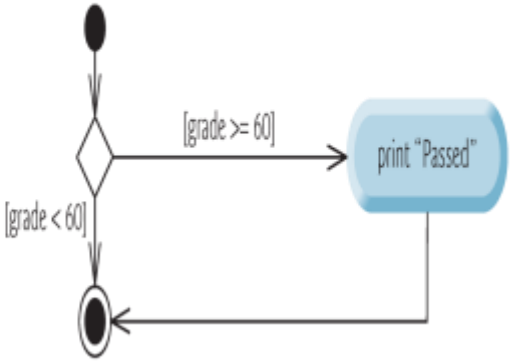


Fig. 3.2 | if single-selection statement UML activity diagram.

What You Would Learn

- Of course the object-oriented design and analysis
- Typically, you are going to learn something about
  - requirement engineering (UML)
  - design pattern (including information hiding, design principles,etc)
  - refactoring
  - LLM-based software engineering?

Your Projects

- Each group picks one problem from a pool
- We created 4 projects for you. Yet you can work on your own if you want to.
- Come talk to me if you want to come up with your own ideas. DO EXPECT THAT YOUR IDEAS MIGHT BE ASSIGNED WITH A LOWER STARTING SCORE.
- One contact person is needed for each group (This year, all the project requirements are proposed by student assistants. It is pretty necessary to contact them during your progress. They are the bosses!).

The Project List

- LLM-Powered AI Bot Platform: Create a llm-powered AI bot platform that integrates multiple existing large language model interfaces, such as OpenAI, while also supporting the creation of custom bots. The platform should include features like search, ratings, and purchase functionalities.
- Online Open Courses: Create a course learning platform to realize the creation and upload of course materials.
- Guandan Game: Guandan is a new kind of card leisure game
- Mini Black Myth: Wukong: Make a 3D adventure game in which the player will go through challenges and eventually achieve a goal to clear the game, in your own implementation of Black Myth: Wukong.

LLM-Powered AI Bot Platform:

- Basic Requirement (75%) :
  - **Support for Two Types of User Roles:** System administrators and regular users.
  - **Bot Module:** The platform's core module, serving as the carrier for user interactions, must include both default official bots and customizable bots.
    - Official Bots: At least include Chatgpt3.5-turbo, Chatgpt4o, and Chatgpt4o-mini.
    - Custom Bots: Users should be able to create bots with specific functions, such as translation, image generation, math calculations, etc.
  - **Administrator Module:**
    - Admins can add or modify the default bots and set usage limits.
    - Admins can set pricing and usage quotas for custom bots, with customizable forms for setting these limits.

LLM-Powered AI Bot Platform:

- Basic Requirement (75%) :
  - **Conversation Module:**
    - Each conversation starts with creating a new bot, either from the official bots or a custom bot created by the user or others.
    - Must support basic Q&A functionality:
      - Single-turn Q&A and multi-turn history-based Q&A.
      - Features like clearing the conversation context.
      - Model responses should be displayed in a streaming output format.
  - **User Information Module:** At a minimum, it should include interfaces for user profile modifications and a user homepage to display custom bots, usage stats, and other users' comments and ratings.
  - **Marketplace Module:** Users can top-up credits and purchase tokens. Different bots, based on their models, require different amounts of tokens. If users run out of tokens, they can only use the free default bot (Chatgpt3.5-turbo).

LLM-Powered AI Bot Platform:

- Basic Requirement (75%) :
  - **Search Module:** Support fuzzy search for both users and bots.
  - **Ratings/Posts Module:**
    - For Users: Users can leave comments, rate, or post on other users' profiles. Notifications are sent via email.
    - For Bots: Users can rate bots themselves or provide feedback on specific responses.
    - For Adminstrators:
      - Admins can export bot ratings (positive and negative feedback) into an Excel spreadsheet.
      - Admins can export stats on total users, bots, and revenue into an Excel file.

LLM-Powered AI Bot Platform:

- Advanced Requirement (25%)
  - **Popularity Rankings:** Display and rank the latest bots, top-rated bots (best of the month, best of all time, most visited).
  - **Advanced Custom Bot Settings:** Allow enhanced customization for bots, including an external knowledge base for queries, predefined prompt templates, and improved communication tools for user interaction.
  - **Recommendations:** Suggest bots based on the user's frequently used bot types or topics when creating a conversation.
  - **Support for Multiple Query Formats:** Enable users to ask questions via text, images, files, and voice inputs.
  - **Prompt Refinement:** Provide users with enhanced prompts to improve the quality of their queries.

LLM-Powered AI Bot Platform:

- Advanced Requirement: 25%
  - **Custom Model Tuning:** Offer fine-tuning for bots using specific datasets, enabling them to perform more specialized tasks.
  - **Next-Prompt Suggestions:** Based on the bot's answers, suggest potential follow-up questions for users.
  - **Incentive System:** Admins can reward users for popular or highly-rated custom bots through incentives, such as credits or other forms of compensation.
  - **Multi-Bot Conversations:** Allow users to @mention other bots during a conversation with a single bot to bring them into the discussion.
  - **Aesthetics:** Ensure the platform has a visually appealing design.
  - **Client or Mini-Program:** Support for a desktop client or a mobile app/mini-program.
- Stakeholder: Yiwei Ren

Online Open Courses:

- Basic Requirement (75%) :
  - Support three permissions of system administrator, course teacher and student.
  - Course creation must be applied for by the course teacher and approved by the system administrator.
  - The course function needs to include the following specific contents:
    - The course contains different chapters, and the courseware function can be realized for different chapters. Chapters can be categorized: teaching, homework, and project
    - Teachers can add some students to the course.
    - It can be divided into open courses, non-open courses, and semi-open course (open part of the chapter).
    - Students can join open courses.
    - Teachers can send email notifications to students who join the course.
    - Students can give the lesson they have joined a like.

Online Open Courses:

- Basic Requirement (75%) :
  - The functions of the chapter include the following specific contents:
    - Upload courseware module: Teachers can upload courseware for chapters, and the files support at least MD and PDF formats
    - Update the courseware module: Teachers can choose to keep the original courseware, and each version of the courseware is marked with a version number
    - Download courseware module: Teachers can set whether the current courseware is downloadable or not.
    - Video module: Course teachers can upload videos corresponding to chapters, and users can watch them online
    - Comment module: A comment area is reserved for each courseware for user comments and teacher Q&A
    - Attachment module: Teachers can upload attachments corresponding to this chapter, such as data, code, etc. Downloadable for students.
  - Teaching evaluation function: Students can evaluate the course. Feedback scores and reviews.

Online Open Courses:

- Advanced Requirement (25%)
  - Popular courses and popular teachers list.
  - Add homework module and courseware viewing progress module.
  - Implement video anti-cheat function,
    - If you have to see it for a certain amount of time;
    - Only one video can be played at a time;
    - When the viewing time reaches a certain time, detect whether the user hangs up;
    - End-of-course requests cannot be invoked directly;
    - Single-user login only, etc.
  - Live broadcast room of the course.
  - Set specific indicators for teaching evaluation: such as the reasonableness of homework, the teacher's teaching ability, the difficulty of the test, etc.
  - Pretty UI.

Online Open Courses:

- Advanced Requirement (25%)
  - Bullet chatting: Give the bullet chat a like, delete bullet chats, etc.
  - Comment area module: Students can share learning resources and upload files.
  - Access to the large model to achieve real-time knowledge Q&A.
  - Data analysis: Provide detailed data analysis reports according to the completion of homework to help students and teachers understand the learning effect and problems.
  - Reward system: Points earned by completing courses, participating in discussions, and other activities can be redeemed for rewards.
  - Implement a client or mini program.
- Stakeholder: Yajing Tan

The Guandan Game

The Guandan Game

- Basic requirements (75%)
  - **Complete game interface**
    - Start screen
    - Lobby/on boarding interface
    - Game interface (3D)
    - Settlement scoring interface
  - **Complete Play:** Play that satisfies the basic rules of the Guandan
    - Legitimacy detection of card type (single card, pair, triple pair, triple sheet, bombs, flush, etc.)
    - Out of the card, ending, timer and other basic functions
    - Report card, upgrade, settlement, 2 of hearts and other rules logic implementation
  - **Basic UI and interaction**
    - Display your hand
    - Keep your own and other players' plays or passes during the round
    - UI for operations such as playing cards

The Guandan Game

- Basic requirements (75%)
  - **User property**
    - User login and registration
    - Statistics of the user's level
    - Statistics of wins and losses and other data
    - Other players can view statistical data in the game
  - **Sound effects and background music**
    - Background music
    - Sound effects when the player is operating

The Guandan Game

- Advanced Requirement (25%)
  - **More beautiful game:** card back, tablecloth, background music, etc., can be changed
  - **AI Man-machine battle:** Man-machine mode using algorithm or model, rather than random play
  - **Match mode and segment:** The server matches players of similar levels based on segment
  - **Communication and conversation:** You can send text conversations and memes to players in the hall and the bureau
  - **More ways to play cards:** No shuffling, etc.
  - **Save and replay the game**
    - Can save the game
    - The finished game can be replayed, and the unfinished game can continue
- Stakeholder: Zengrong Huang

Mini Black Myth: Wukong

Mini Black Myth: Wukong

- Basic Requirement：75%
  - **Game Scene:** the game should consist of 3 (2 for teams of three students) levels which include following contents:
    - A boss in each level. The players can only complete the level by defeating the boss. After defeating the boss, the player will attain an ability/item that is going to play a role in later gameplay.
      (Boss fight in any form is acceptable as long as it makes sense)
    - At least a maze challenge, a puzzle challenge and a collecting challenge in the entire gameplay experience (Choose 2 out of the 3 challenges to finish, for teams of three students only)
      - Maze challenge: The players shall not pass unless they understand the map layout correctly.
      - Puzzle challenge: The players shall not pass unless they figure out the puzzle and behave correctly.
      - Collecting challenge: The players shall not pass unless they have collected all the required items.
    - Visual：Make primary beautification on scenes (Applying texture/Rendering)
    - Audio: Background music and sounds for major actions/events.

Mini Black Myth: Wukong

- Basic Requirement：75%
  - **Character Behaviors:** the main character of the game should:
    - Have some attributes (e.g. HP, as a necessary one)
    - Be able to move and jump
    - Be able to interact with the mechanisms in the scene
    - Be able to pick up collectibles
  - **User Interface (UI):** the game should includes the following UIs:
    - Start Screen: Designed by yourself according to the game
    - Settings: Where the player can adjust the settings of the game, such as volume or mouse sensitivity
    - UI during the game: Provide necessary information:
      - current HP
      - current progress
      - other information the player is supposed to know
    - Game over Screen: Inform the player of their final success or failure of the game.

Mini Black Myth: Wukong

- Advanced Requirement：25%
  - **Further aesthetic design**
    - Stylized rendering
    - High-quality art design of scenes
    - Visual effects
    - Exquisite UIs that suit the theme of your game
    - Animation for character's interaction with objects in scenes
    - Comprehensive and high-quality audios
  - **Improvements on gameplay experience**
    - Tutorial & guidance: Make every newcomers able to complete the game
    - Switching perspective or camera's evading obstacles & occlusion handling on corner
    - Minimap
    - Game pause & resume
    - Save and load
    - Loading screen between levels
    - History records & ranking list

Mini Black Myth: Wukong

- Advanced Requirement：25%
  - **Extra contents (need to be meaningful to the gameplay)**
    - Backpack & equipments
    - Item crafting
    - Buff/defuff system
    - Trading system
    - Skills
    - Complex action system
    - Character progressing system
    - Missions / Tasks
    - Interactable NPC
    - Achievements
    - Map with symbols and mark of current location
  - **Multiplayer (need to include gameplay that is designed for multiplayer)**
    - support multiplayer game with multi-device as input
    - support multiplayer game through LAN

Mini Black Myth: Wukong

- Advanced Requirement：25%
  - **Including identifiable elements of SUSTech in gameplay (in any form)**
  - **Other content that contributes to the gameplay but is not mentioned above (need to be reviewed)**
- Stakeholder: Shaolin Huang

Tips for your projects

- Frequently contact your stakeholders. They manage the requirements and have written detailed descriptions.
- Launch your projects ASAP. You don't want to start off just two weeks before the final ddl.
  - Whoever accomplish the projects and present them on mid-term presentation can be awarded with a bonus of 10% of your final project score.
- If you want to be better graded, you should go for as many bonus points as possible.
- You need to run your deliverables with test cases.
- Don't simply rely on the technical leader (大腿) in your team. We would grade you based on your individual contributions to the team in a rigorous manner.

QUESTIONS?