GAME THEORY, GAMIFIED

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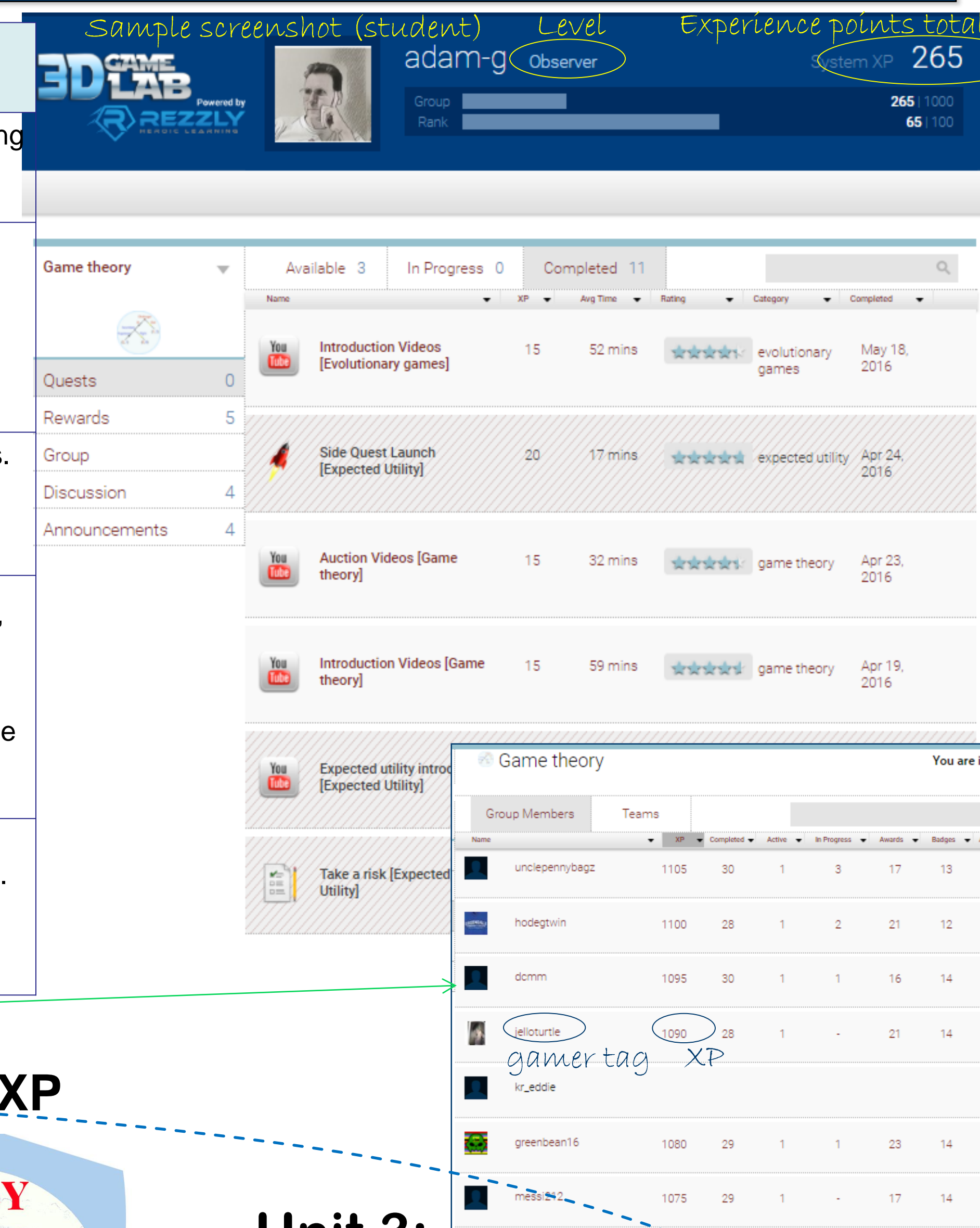## We delivered an introductory level game theory course as a quest-based, gamified course.

Why?

We used quest-based learning in order to
- increase students' engagement with game theory in the classroom and outside;
- give students more agency and have students take charge of their learning;
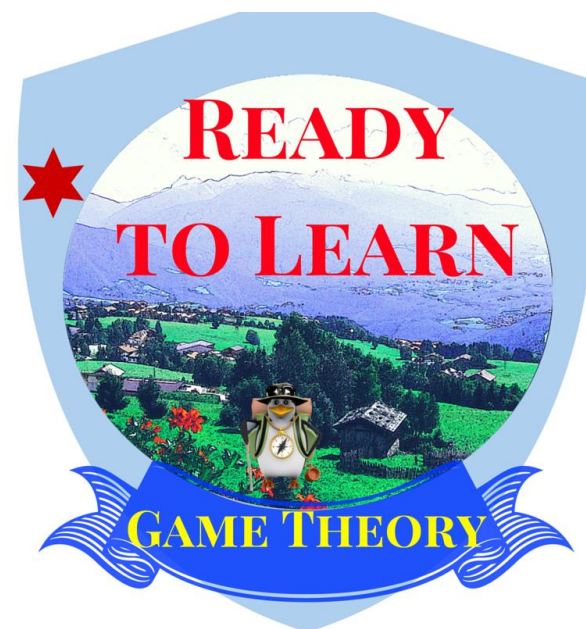- achieve better long-term learning outcomes.

What?

- **Gamification:** We introduced game elements into the course (see table).
- **Flipped classroom:** Concepts were explained mostly in videos that students watched before class, while class time was devoted to discussion, problem solving, working on side-quests, and presentations of side-quest results.

How?

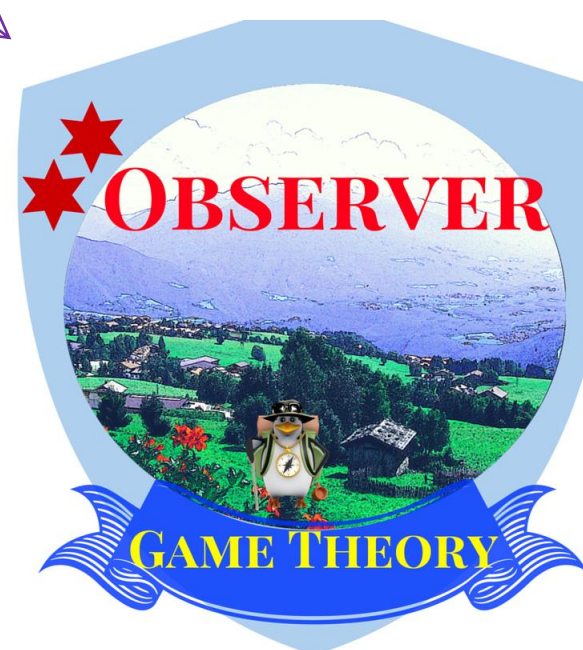| Elements of gaming experience	What is it?	How did we implement it?
Progression	Continuously advancing by achieving increasingly challenging tasks; "leveling up."	Students moved through levels (see path below) by completing quests and earning experience points. Expectations for side-quests increased as the course went on.
Voluntary participation	Bernard Suits wrote: "playing a game is a voluntary attempt to overcome unnecessary obstacles." In other words, it is not a game if you have to play. Voluntary participation is important in a gamified system because it achieves intrinsic motivation by handing the players choice and the ability to increase their self-efficacy.	Side-quests were student-designed; all quests were optional, though some were necessary to "unlock" side quests. It was possible to skip a side-quest for one unit and make it up by doing two for another unit. Almost all course activities were optional, and students were driven by their desire to advance in the "game" and to learn.
Playfulness	Being in the mindset of playing is part of what makes gaming fun. This cannot be achieved simply by adding badges, points, etc. to a course; playfulness must be meaningfully incorporated into activities.	We encouraged creativity and experimentation in side-quests. Students made videos, led in-class experiments to demonstrate concepts, did surveys on campus to document decision making biases.
Feedback	In games, players usually receive clear, immediate, and detailed feedback. An achievement brings both extrinsic rewards (points, a badge, etc.) and intrinsic rewards (a feeling of accomplishment). Failure is usually not final: the player can learn from it and try again.	Students receive experience points for quests, badges for completing side-quests and for leveling up, "classroom coins" for participation, extra XP for especially creative work, etc. Quest submissions were usually evaluated within a day, and either approved or returned with comments detailing what else needed to be done. Instead of grades, students received points and badges or instructions for completing the quest.
Cooperation / Competition	Successful games often feature cooperation with other players and perhaps in a team with a competition that motivates players to climb the "leaderboard."	Side-quests for each unit were typically done in teams, and students collaborated closely with their teams for side-quests. At the same time, students were quite competitive in moving up the leaderboard, which showed the total XP for each student.

Sample screenshot (student) — Level — Experience points total
adam-g Observer 265

100+ XP — READY TO LEARN — GAME THEORY

Badges awarded for leveling up

200+ XP — OBSERVER — GAME THEORY

Introduction: Detailed syllabus; how this course is different

300+ XP — KAHNEMAN KID — GAME THEORY

Unit 1: Decision biases
Analyze speeches of presidential candidates to see if they strategically use various common decision making biases such as loss aversion or anchoring

Unit 2: Probabilities
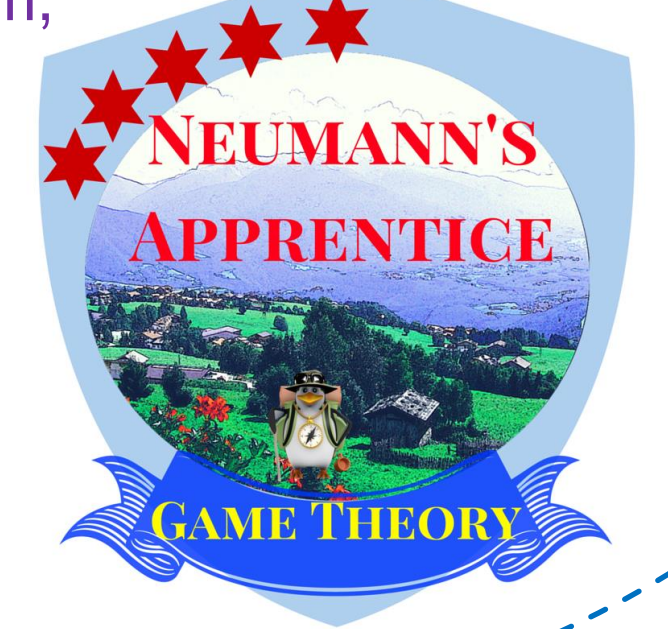*Analyze strategies in "5-card draw," a simple version of poker*

400+ XP — BABY BERNOULLI — GAME THEORY

Unit 3: Expected utility
Explore applications in insurance (certainty equivalent, risk premium, actuarially fair, etc.)

500+ XP — NEUMANN'S APPRENTICE — GAME THEORY

Sample unit

Unit 4: Game theory intro

Do before class
- Watch videos on new topic (15 XP) → *I created some of the videos, and assigned some created by others.*
- Take a quiz online on new concepts (15 XP) → *Quiz can be retaken several times; goal is to watch videos and retake quiz until concepts are clear.*

First class
- Problems solving in teams / class discussion (20-40 XP) → *Sometimes this class includes mini-lectures on concepts that were especially difficult (as revealed by quiz results).*

Second class
- Side-quest launch: choose topics and teams (20 XP)
  Types of side-quests: *Students form teams around their interests for the side-quests, choose a type of side-quest, and start working on it. Instructor (and assistants) help teams define their side-quests.*
  - 🎬 "For your viewing pleasure:" create a video
  - ⭐ "I put on my robe and wizard hat:" create a presentation
  - 🔑 "From theory to practice:" real-world application of concept
  - "Game theorist:" design a game or study a real-world game
  - "Experimenter:" design an experiment or survey

Do in teams, outside class
- **Do side-quest (35 XP)**

Third class
- Quest sharing
  ↳ *Show the video, or deliver the presentation, or share the game, etc.*

Examples of side-quests for each unit in purple

Sample comments

"QUEST-BASED COURSE!!!! I am finally in class where I get rewarded for working hard and not for being good at taking tests."

"I really enjoyed the rewards system. I felt that I didn't have to worry about grades if I made sure to do the work, which allowed me to focus on just learning. I also really liked how quests would be returned and turned in for full credit as opposed to getting partial credit for subpar work."

"Those videos were helpful however, this might just be me, I like an instructor explaining things in class where direct questions can be asked."

Unit 4: Game theory intro
Write a program that plays R-P-S against a human player using insights from the literature on this game

600+ XP — SCHELLING BELIEVER — GAME THEORY

700+ XP — NASH KNIGHT — GAME THEORY

Unit 5: Extensive form games
Model a real-world situation and find the equilibria

Lessons learned

Worked well:
- We had much greater engagement, excitement, increased autonomy, truly a different learning mindset as compared with the conventional delivery of same course
- The leaderboard, levels, and XP worked very well to motivate students—better than grades
- Students pursued a variety of interesting, creative side-quests and learned about topics that they were particularly interested in; they even pursued "extra side-quests" for fun and XP

Challenges:
- Some students chose to pursue fairly easy quests, while others chose to challenge themselves with more interesting ones
- As the course progresses and topics become more complex, the job of advising, supervising and guiding side-quests becomes more and more difficult and demanding for instructor
- The usual issues with teamwork

Teacher's perspective
- Startup costs are significant for creating a gamified course
- Instructor must embrace the spirit of a gamified course; simply introducing badges, XP will not gamify a course
- Many students will initially be uncomfortable with course structure, so explaining the syllabus in great detail is imperative
- Prompt feedback on quest submissions is crucial
- Quests are approved or returned with comments for resubmission, which means more work for instructor, but also more feedback and learning for students

Unit 6: Evolutionary games
Explore and modify a NetLogo model; study stable outcomes as parameters change

800+ XP — EQUILIBRIUM SEEKER — GAME THEORY

Unit 7: Repeated games
Create strategies for an Axelrod-style iterated PD tournament (which was then run using www.pdtournament.com).

900+ XP — HOMO LUDENS — GAME THEORY

1000+ XP — GAME WIZARD — GAME THEORY

All units: Additional topics as introduced through students' side-quests

Terms

Quest: All activities in this course are called quests, and they range from simple and easy (such as watching a video) to more involved and demanding (such as side-quests).

Side-quest: a mini-project that a student or a team defines within given parameters and completes in about a week. The outcome may be a write-up, a presentation, a video, a survey, an experiment…

Experience points (XP): Students receive these points for completing quests, for class participation, for course activities generally.

Badge: A "prize" for some achievement, such as completing a difficult quest, solving a puzzle, outstanding class contribution…