

Part 1: OVERVIEW

What is it?

It is a system of best practices, tools, templates (*digital and instrumented*) that helps faculty deliver consistent and student-centered project based learning courses. It is a platform that allows faculty to focus on coaching, content delivery, and building relationships with students and sponsors.

The IPRO Operating System is a more contemporary approach for outlining the key activities required to successfully complete an IPRO project. It balances tight / loose principles. Items that are tight (*how meetings are run, how projects are managed*) are programmed and consistent to ensure that items that are loose (*project themes, project ideas*) can be the focus of the work. Students and faculty will determine the content and context of IPRO courses. Elements such as taking attendance and project management are partially automated.

Requirements for Successfully Completing IPRO:

- Select and Work on a Project you Care About
- Attend Class
- Earn Four Badges at Enrichment Sessions
- As a Team, Create and Maintain a Social Contract.
- As a Team, Assign an Engagement Manager
- As a Team, Develop a Clear Problem Statement
- As a Team, Develop and Manage a Kanban Board.
- As a Team, Finish at Least Three Think, Build, Test Iterations.
- As a Team, Conduct Weekly Team Stand Up Meetings with Faculty and TAs.
- As a Team, Conduct Four Pitch and Critique Sessions
- As a Team, Produce a Final Deliverable

Part 2: INDIVIDUAL ASSIGNMENTS

> Select Work on a Project you Care About

Why does this matter?

We know students do better work when they are working on a project they care about. You will be more motivated to participate and have a greater sense of accomplishment when the semester is completed. We also hope this project will be something you talk about during job interviews and grad school interviews – if you are passionate about the work, your interview will be more successful.

How will this work?

On the first day of class, you will fill out a short survey called “the sorting hat”. This will help us determine your working preferences, experience, and objectives. You will receive a brief report based on your answers. The instructors will use this information to help sort you into teams. Like the fictional sorting hat, you will also be able to make clear your preferences. The sorting hat determines *how* you like to work (*mainly hands-on or more research-focused*).

Once you have filled out the survey, you will also be asked to submit an idea for a problem you may want to work on and that is relevant to the course theme. You will have time to think of a variety of potential ideas and then share and review them with your new team members the following week(s). The team discussions will help combine, improve, and narrow down ideas. Keep in mind this is just the starting place for your project and this early idea that your team would like to explore will likely look and feel different when complete. You will also have a chance at “free agency”— you can switch teams if there is an idea created somewhere else in the class that you would like to work on.

Assessment and learning goals

Communication: Students will need to construct an idea and solicit feedback from others. Students will build communication skills for sharing ideas with technical and non-technical audiences as well as skills for providing constructive feedback.

Beginner / NA	Developing	Accomplished	Exemplary
Does not finish the sorting hat nor submits an idea; joins a team that needs an extra team member	Completes the sorting hat and submits an idea; joins the team assigned	Completes the sorting hat and submits an idea; makes a few constructive comments in team setting; considers and reviews all teams with similar working preferences	Completes the sorting hat and submits an idea; makes many constructive comments on other ideas in the idea selection process; decides on team after thoroughly reviewing all project ideas, even from teams with different work preferences

Tools and templates

- The Sorting Hat
- Idea Submittal Form

> Attend Class

Why does this matter?

IPRO is a team and project based class. Class time will primarily be devoted to working in your teams and faculty coaching. We know it can be hard for a team to meet outside of class —that is why it is so important to maximize your time together in class. Your presence is required to help make team decisions, divide work, and interact with the faculty. If you are not in class, your team will not be complete and therefore will not be as effective.

How will this work?

Obviously you will need to come to class. When you arrive you will “tap” in at the IPRO concierge desk – there will be card reader, just touch your ID. If you are more than 10 minutes late for class, you will only receive 50% credit for one attendance. More than 30 minutes late is considered an absence.

Assessment and learning goals

Teamwork: Students will learn the importance of being present with their team. To be a successful team member you need to be there with your team.

Beginner / NA	Developing	Accomplished	Exemplary
Misses 4 or more classes; students cannot get a grade better than a D if they miss 4 or more classes	Misses 3 classes; student cannot get a grade better than a C if they miss 3 classes	Misses 2 classes	Misses only one (or fewer) class

Tools and templates:

- Attendance System

> Earn Four Badges at Enrichment Sessions*Why does this matter?*

IPRO should be an opportunity for you to learn outside of your major. This can include learning new skills or finding a deeper understanding of your discipline outside of IIT. We want to encourage you to have a diverse set of experiences during your IPRO course. The sessions may include everything from attending mini-lessons or learning centers on topics such as user interviews, survey design, and working with circuits to attending events outside of class.

How will this work?

Each semester every IPRO section will offer a series of mini-lessons and learning centers. A mini-lesson will be run by a faculty member or outside expert and will cover a topic relevant to IPRO. These lessons will be held at the Pitch and will last from 20 – 30 minutes. Learning centers will be more student driven. Students will volunteer to present something they have expertise in (*like writing in Python*) allowing other students to engage in dialogue and share their own experiences. Three of four badges must be earned through mini-lessons or learning centers.

The fourth badge is considered a wild card. Each faculty member will outline a handful of events outside of class time (*such as a lecture or a networking event*) that will count for an enrichment session badge. Students may choose one of these events from the pre-approved list. Students may choose to achieve their fourth badge through a combination of mini-lessons and/or learning centers.

IPRO Operating System

Key Activities Required to Successfully Complete an IPRO project

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Students will need to email their assigned TA a brief summary of their experience at each enrichment session. The student should focus on what they learned and how they might use it in their work in IPRO and beyond. The TA will then enter the badge into the system (*this will be a spreadsheet integrated with the attendance application*).

Assessment and learning goals

Problem Solving: Students will learn the value of understanding multiple perspectives and integrating knowledge of disciplines outside of their own when innovating. Students will learn how to leverage methods and tools to help move the innovation process forward.

Beginner / NA	Developing	Accomplished	Exemplary
Fewer than four badges completed	All four badges, all from mini-lessons and learning centers; limited assessment of value and impact in the submissions	All four badges, one outside event; detailed, robust description of what was learned	All four badges, one outside event; detailed, robust description of what was learned and how the learnings will be applied in projects outside of IPRO

Tools and templates

- Fields in Attendance App Spreadsheet
- List of Mini-Lessons Each Semester
- Process for Proposing Learning Centers

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Part 3: TEAM ASSIGNMENTS

> Create and Maintain a Social Contract

Why does this matter?

A social contract is a team-designed agreement. It is an aspirational set of values, behaviors and social norms that will create the environment to do good work - together. Each social contract is custom to the team but usually includes elements related to timeliness, responsibility, conflict resolution, and expectations for work effort. A social contract establishes how the team plans to operate, clearly setting expectations and rules. As the project moves forward, the social contract can help the team reset, move through conflict, and hold team members accountable.

How will this work?

The team will use the provided template to create their social contract. Typically social contracts have between 8 – 10 elements. The final social contract will be reviewed by the faculty. Each week every student on the team will answer three questions on a simple survey (using red/yellow/green options):

1. *Did I (as an individual) uphold the social contract this week? (R<Y<G)*
2. *Did the team as a whole uphold the social contract this week? (R<Y<G)*
3. *Open text – please explain if either of the answer above are yellow or red*

The team will be able to see a composite ranking of their answer each week, allowing them to keep track of their compliance with their team’s social contract. The faculty and TAs will also be able to view all answers and the composite score. They may choose to use the weekly stand up meeting (*described later in this document*) to address any concerns surfaced through the social contract.

Assessment and learning goals

Communication: Students will learn how to communicate the social and team related elements of the project. Students will learn to use the “*may I give you some feedback, I observed, which made me feel, therefore could we...*” framework to address group and teamwork issues (*i.e. divergences from the social contract*).

Teamwork: The social contract is the cornerstone of any highly functioning team. Students will learn how to assess and repair group dynamics.

Beginner / NA	Developing	Accomplished	Exemplary
Assessment not completed each week	Completes assessment each week; limited assessment of “reds and yellows”	Completes assessment each week; thoughtful reflection on “reds and yellows” by individuals that allows faculty / TA to intervene and improve (or refine) group dynamics	Completes assessment each week; thoughtful reflection on “reds and yellows” that leads to group discussion and resolution (run by the group, not the faculty)

Tools and templates

- Social Contract Template
- Social Contract Review Form
- Social Contract Dashboard
- Difficult Conversation Template

> Assign an Engagement Manager

Why does this matter?

An IPRO team should operate like a consulting team or a team of programmers – a flat hierarchy with each team member expected to be an engaged contributor. Even though the team members will operate as equals, there needs to be a team manager that is responsible for the final schedule, assignments, facilitation, and tie breaking when there is a split decision.

How will this work?

Becoming an engagement manager is an option, not a requirement. Often a vote is not required since only one team member may want to take on the extra work. If more than one team member wants the opportunity to be the engagement manager the TA will help to set up a scheduled rotation (*for example one team member will be the engagement manager for the first five weeks of the project and then will hand off the responsibilities to another team member*). The engagement manager will meet with the faculty and TAs, separately from their teams and with the other engagement managers in the class, each week. This short meeting will help all engagement managers discuss their challenges and ideas. Faculty will share leadership concepts and training during these sessions. The engagement manager will:

- Be responsible for team progress and schedule compliance
- Help plan and execute the weekly meetings (with the team and faculty). Includes setting agendas, outcomes, and making sure the team contributes
- Go to the faculty if there are obstacles that are impeding the team's progress
- Act as a tie breaker, facilitator, and mediator to achieve consensus

Assessment and learning goals

Teamwork: All students will learn leadership concepts and the role of a leader. They will also learn that there are many types of leadership including servant-leadership and facilitation.

Communication: Students that choose to be an engagement manager will learn critical leadership communication skills related to organizing and motivating a team.

Beginner / NA	Developing	Accomplished	Exemplary
Does not assign an EM, or assigns an EM but the EM does not perform any specific functions	Assigns an EM; EM focuses on process compliance but does not help with group dynamics & relationships	Assigns an EM; EM helps team stay on track and accomplish all of the work required	EM motivates the team and helps individual members take on new challenges and grow

Tools and templates

- Leadership Playbook

> Develop a Clear Problem Statement

Why does this matter?

Over time we have observed that successful IPRO teams usually have a clear problem statement which guides their project. A good problem statement has:

- No solution in mind, allowing the team to create a truly new and novel solution. Having a solution in mind will bias the team to a specific direction and limit creativity.
- Many concrete answers, allowing the team to investigate a variety of possible directions, not falling victim to failure of the imagination.
- A basis in fact, allowing the team to focus on a real problem, not an assumption.
- A clear user and need, allowing the team to focus on solving the needs of a real user group, ensuring the eventual solution is meaningful and worth implementing.

How does this work?

After project selection, each team will be responsible for articulating a problem statement that they want to work on for the remainder of the semester. As students gain more information, they will be able to refine and adapt the problem statement. This is only to be done deliberately and with the consensus of the whole team. Each week, at the stand up meeting, the team will start by reminding the faculty and TAs of their problem statement. If it has changed, they will say, *“our previous problem statement was X... but now we are working on Y... because (set of new facts)... therefore we will...”*

The problem statement will be reflected in the Kanban board (*see below*). Teams will be provided a template and examples. The template is fairly simple:

- *Who is our user? (A specific group of users, the more specific the better)*
- *What is their need? (A gap between actual and ideal, just, safe, usable, and so on)*
- *Why is it worth solving this problem? (Set of facts that suggest a positive impact if the problem is solved)*

Assessment and learning goals

Problem Solving: The students will learn how to articulate a real and meaningful problem statement. This is the first step of most problem solving processes.

Communication: Students will learn the value and importance of using a problem statement to help guide all project communications and presentations.

Beginner / NA	Developing	Accomplished	Exemplary
No problem statement or a problem statement based on a technology or solution	Includes key fields, but user is too vague / abstract; needs are not well articulated, and/or there is little evidence of impact and importance	All fields of problem statement are specific, real (based on facts), and have no solution in mind	Well crafted problem statement that evolves over the course of the project

Tools and templates

- Problem Statement Template

> Develop and Manage a Kanban Board

Why does this matter?

Contemporary project management methods, such as the Kanban board, build a culture based on trust and transparency, helping teams work more efficiently. The Kanban board will enable the team to break down their complex project into smaller, more manageable “releases”. (see next item: *build, think, and test iterations*). This practice reduces risk and waste during the semester. The Kanban board helps create the following team and project qualities:

1. Proactiveness - *Work is pulled, not pushed*
2. Transparency - *Workload is transparent, so everyone knows who is doing what*
3. Definition - *Everyone defines acceptance criteria for each task*
4. Agreement - *Everyone agrees that the acceptance criteria have been met*

How does it work?

Each team will develop and manage a Kanban board. Faculty and students are free to choose their own way to create a board (*including analog options such as butcher paper and sticky notes or digital services such as Trello*). At the beginning of the project, students will develop an initial Kanban board (*based on their problem statement*) and then add to the backlog section as new elements are required. The faculty and TA will be able to view the Kanban boards between classes, helping them monitor progress and to make sure the students are working on the project in an effective way. This will also enable class discussion to be more productive.

Students will define tasks for each release. They will also define acceptance criteria for each task and estimate the task’s size (*complexity and priority*). The team will then select and finish the tasks. Students may also use the board to ask questions (*allowing this to happen while the work is being completed and not waiting / delaying to class time*). The teams will move the tasks from back log to in progress to complete to accepted.

Assessment and learning goals

Teamwork: This method will teach students how to be an effective team member

Beginner / NA	Developing	Accomplished	Exemplary
No Kanban developed or rarely used, little to no team management evident	Kanban constructed; tasks are not posted or assigned every week; team management is irregular	Kanban is kept up every week; team is citing and assigning tasks and using “done”; acceptance criteria are not used very often, team management is regular & evident	Kanban is kept up every week; team is citing tasks & size; acceptance criteria are defined and used to review “done”; team has learned to push and pull work & use Kanban effectively

Tools and templates

- Kanban Overview Video
- Kanban Template in Trello

> Finish three releases (at least three think, build, test iterations)*Why does this matter?*

A “release” is a version of your solution. Each successive release should be an improved, refined version. Breaking the semester into three cycles of release —short feedback loops between teams and their end-user —helps create a habit of pivoting and eliminating processes, activities, and products that do not directly result in value for the user or technology. This prevents teams from spending 15 weeks pursuing a solution that is not desirable, viable, and feasible. The first version will never be perfect, but it will provide enough context and information to help the team understand key gaps and critical issues. It also gives the team a chance to pivot to a different direction if required.

How does it work?

Each team will use the Kanban board to plan their release. The process should include think, build, and test phases. A release may be as short as one week but will likely not be longer than 8 weeks. Faculty and students are free to plan their releases based on the project needs. It is helpful to think of a release as a project based learning version of a mid-term exam. It is a way to ensure that students are on track and achieving the learning goals.

Although teams should have agency to plan the release, all releases should include three phases:

- **Think:** This is often the phase where students frame the problem and conduct research. It may also be composed solely of student reflection and discussion. It may also include faculty lectures on the issue or technology. Students should be working on their problem statement in this phase. It is important not to skip this phase – make sure the team team understands the nature of the problem and its context. They should also use the think phase to discover existing solutions to the problem or issue.
- **Build:** In this phase student develop a solution to the issue (*or multiple solutions*). This may include brainstorming, concept selection, prototyping, and detailed design work. Although it may seem counter intuitive, a research paper can also be “built”: assembling and writing the paper.
- **Test:** This phase can include everything from physical and mechanical testing of a prototype to testing concepts with users to workshopping a paper with key experts. The teams will need to identify their core assumptions about their idea (*what would need to be true in order for this idea to succeed*). They then need to test those assumptions. These tests should be fast and low cost. The primary question: *Is the concept or idea doing what it is supposed to do?* Again, this is just as important for a research paper as it is a physical prototype.

Assessment and learning goals

Problem Solving: The method of multiple releases is considered an agile project management technique. This is a contemporary method of problem solving that our students will likely need to know when they graduate.

Beginner / NA	Developing	Accomplished	Exemplary
Creates only one release, or executes only one phase (for example only finishing the build phase) for each release	Attempted to finish all releases and phases but skipped a release or phase	All releases and phases completed, but based on initial estimate of timing not the nature of the project (they made a first plan and stuck with it, did not modify schedule as more information was gained)	Releases and phases planned based on the nature of the project. All releases and phases completed

Tools and templates

- IPRO tools segmented into Think, Build, Test categories
- Release Feedback Template

> Conduct a weekly team “stand up” meeting with faculty and TAs

Why does this matter?

It is important for a team to learn how to quickly communicate the status and key issues of their project to engagement managers and advisors. This can be considered a triage activity— helping the team and their advisors quickly cover the current status of the projects and identifying issues that need to be addressed in more depth. The advisors can quickly meet with all teams then redeploy resources to high priority needs or based on capability and experience. This meeting (*and the associated documentation*) helps to ensure that the teams are making progress and following a process.

How does it work?

A small team of faculty and TAs will meet individually with each team at the beginning of class. These meetings should take no longer than 8 minutes. The engagement manager (*or someone that volunteers or is selected by the engagement manager*) runs the meeting. They go over:

- *What did we do last week?*
- *What do we plan to do this week?*
- *What barriers did we face?*
- *What questions do we have?*

The content for these four areas will be entered into a form. The faculty will review the form from the previous week in preparation for each week’s meeting. The form will be “running” so that you can observe the progress (or lack of progress) of each team. The faculty and TAs will give some brief comments and identify any more substantive issues they need to address with the team once all meetings are completed.

Assessment and learning goals

Communication: Students will learn to quickly communicate the technical and non-technical aspects of their projects in a compact but rich way.

Beginner / NA	Developing	Accomplished	Exemplary
Team does not run a meeting each week; multiple team members absent for each meeting	Poorly organized or extemporaneous meetings	Team follows process and makes tangible progress each week; Engagement manager runs each meeting	Team follows process and makes tangible progress each week; all team members participate in the stand up meeting; team shows prototypes and/or progress on papers

Tools and templates

- Stand Up Meeting Form
- How to Conduct a Stand Up Meeting Video

> Conduct Four Pitch and Critique Sessions

Why does this matter?

It is very easy, when working on an effective team, to think that you are going in the right direction and have thought of everything. This feeling can be fatal for a team. It is helpful to get frequent feedback from teams working on different solutions to the same problem. They can help you understand where your arguments are faulty and what you may have missed. This is also a way for teams working on “hands on” projects to interact with teams working on “research and theory”. These sessions will also help students improve their critique skills— the ability to give useful feedback to colleagues and other teams.

How does it work?

At four times during the semester your team will partner with another team in a Pitch (*presentation*) and Critique (*feedback*) session. It is fine to present to the same team twice but not three or four times (*aim to work with a different team each time*). Your team will take 8 minutes to present your work including your problem statement, which release you are on, and the opportunities and challenges you have observed. The team listening to the pitch will give you feedback (*what worked, what did not, have you thought of... questions*). You will then switch roles with your partner team and give them feedback.

Assessment and learning goals

Communication: Students will learn to give constructive, tangible feedback on the ideas of others. They will also learn how to communicate their ideas to non-expert audiences.

Problem solving: A key part of problem solving is seeking out an integrating feedback from others. Students will learn the role of critique in problem solving.

Beginner / NA	Developing	Accomplished	Exemplary
Team is not ready to give a pitch; feedback for partnering team is minimal and/or not helpful	Team has a half-baked presentation that is hard to understand; little to no materials explaining the idea; feedback for partnering team is adequate	Team has prepared a pitch; presentation materials are easy to understand; solid feedback for partnering team is provided	Team has prepared a well-constructed, engaging, thoughtful pitch; presentation materials are of high quality and easy to understand; thought-provoking and useful feedback for partnering team is provided

Tools and templates

- Feedback Template
- Heard / Saw / Learned Template
- Video on How to Give Critique

> Produce a final deliverable

Why does this matter?

Although much of this project is focused on learning process tools and techniques, in order to be successful you need to put something out into the world. The final deliverable will be a synthesis of all of the hard work completed over the project. You can then use the final deliverable to talk about all of the skills and methods you learned during the project— it will be a critical portfolio piece for graduate school interview and job interviews.

How does this work?

The team must produce either

- PowerPoint / Oral presentation with a Working Prototype
- Comprehensive Research Paper + Oral Presentation

The requirements in for each option will be included in guideline documents.

IPRO Operating System

Key Activities Required to Successfully Complete an IPRO project

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Assessment learning goals

Communication: Students will learn how to produce a detailed, informative, and professional final deliverable.

Teamwork: Students will learn how to work as a team to produce a professional quality final deliverable and presentation.

Beginner / NA	Developing	Accomplished	Exemplary
Final deliverable incomplete	Work does not meet professional standards outlined in guideline document	Work meets the professional standards outlined in the guideline document	Work exceeds the standards outlines in the guideline document

Tools and template:

- Guideline Document for Comprehensive Research Papers
- Guideline Document for Power Point and Working Prototype
- Guideline Document for Oral presentations