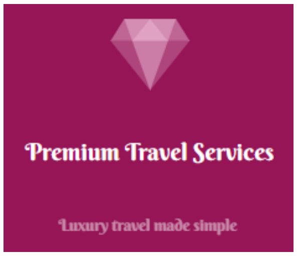
Semester Project – Object Oriented Analysis and Design

This is an introduction to your project. The project will be completed by you (if working alone) or by you and one partner. You must declare your intent to work alone or with a partner by the next lecture.

Scenario

You are an independent consultant creating well-designed custom applications for customers who can afford great quality work.

Your customer, Premium Travel Service, wants a new reservation system. Premium Travel Service books trips for very wealthy clients who like private travel in jets, helicopters, yachts, and limousines.



Premium's clients do not go to a travel web site, choose an airline, choose a date, choose a seat, etc. Rather, they call Premium and say something like this… "Hey, this is Poe Pickles! Take me and 5 of my closest friends to my private island near Fiji on Friday, October 5th at 10AM. Pick us up at Casa Pickles in LA. Bring us back two weeks later to Pickles Palace in San Diego. Thanks!"

Bill Bryson, a Premium travel agent, uses your reservation system's UI to create a new trip, reserve the various packages necessary to complete the client's trip, then take payment for the trip. "Mr. Pickles, your trip is reserved. The total cost will be $74,000. How will you be paying?" Mr. Pickles replies "Ugh, how should I know? Call my money guy. I'm too busy to pay for things."

You cannot generate an itinerary for Mr. Pickles until payment in full is recorded in the system.

Next, Bill Bryson calls Mr. Pickles' Money Guy who replies "Here's an Amex SuperRich card… that should cover everything. Be sure the trip is top-of-the line and spare no expense!"

Once payment is accepted, Bill Bryson adds a nice personal note to the order, then prints the itinerary on expensive paper to send Mr. Pickles (along with a $500 bottle of Mr. Pickle's favorite drink).

When printed, Premium Travel Services requires Mr. Pickle's itinerary to look something like this:

Itinerary by Bill Bryson, 555-123-1234

Mr. Pickles – Your trip to Fiji is all set. I have booked top-quality transport for every leg of your trip. I am including a fine bottle of your favorite drink, Boones Farm Sunshine Pink, to enjoy along the way. If you have any questions or problems, call me anytime. Safe travels! Bill Bryson, Certified Premium Travel Service Agent

- **6 Travelers**
    1. Mr. Poe Pickles
    2. Mr. Pickle's Friend #1
    3. Mr. Pickle's Friend #2
    4. Mr. Pickle's Friend #3
    5. Mr. Pickle's Friend #4
    6. Mr. Pickle's Friend #5

- **Trip Details, beginning 10/5 at 10AM and ending at 10/20 at 3AM**
    1. Helicopter from Casa Pickles to Los Angeles Airport
       10/5 at 10AM, arriving 10/1 at 11AM.
    2. Private Jet from Los Angeles Airport to Fiji Airport
       10/5 at 12PM, arriving 10/1 at 10PM.
    3. Limousine from Fiji Airport to Fiji Marina
       10/5 at 10PM, arriving 10/5 at 11PM.
    4. Yacht from Fiji Marina to Paradise Pickles Private Island
       10/5 at 11PM, arriving 10/5 at 9AM.
    5. Yacht from Paradise Pickles Private Island to Fiji Marina
       10/19 at 9AM, arriving 10/19 at 5PM.
    6. Limousine from Fiji Marina to Fiji Airport
       10/19 at 5PM, arriving 10/19 at 6PM.
    7. Private Jet from Fiji Airport to San Diego Airport
       10/19 at 6PM, arriving 10/20 at 2AM.
    8. Helicopter from San Diego Airport to Palace Pickles
       10/20 at 2AM, arriving 10/20 at 3AM.

- **Booking**
  Every detail your trip was booked with care by Bill Bryson. If you have any questions or problems, call Bill Bryson at 555-123-1234 anytime, 24 hours a day.

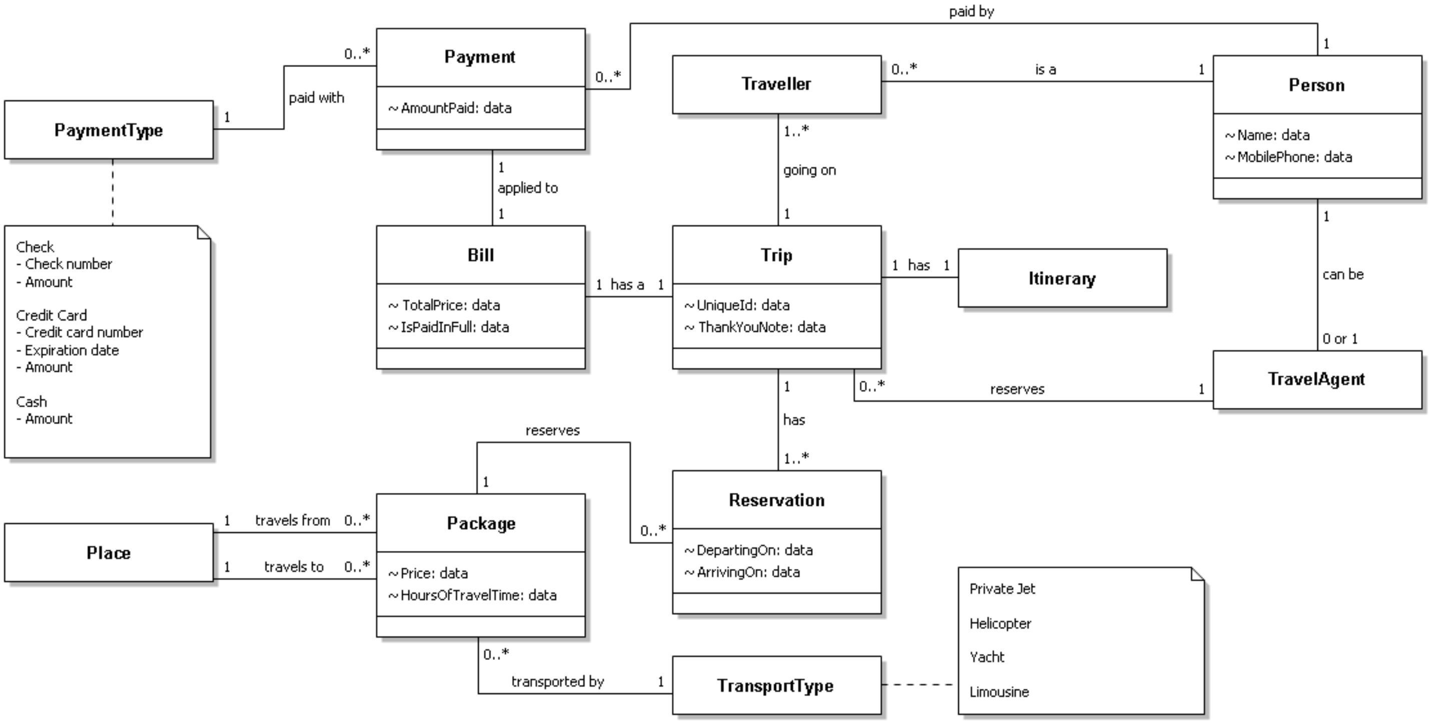
- **Billing**
    - Total: $74,000
    - Paid in full by Mr. Pickle's Money Guy using Credit Card:
        - Card number: 123-123-123
        - Expiration date: 1/1/2099
        - Amount: $74,000

- Billing Details
    - Helicopter from Casa Pickles to Los Angeles Airport on 10/5 at 10AM, arriving 10/1 at 11AM.
      $4,000
    - Private Jet from Los Angeles Airport to Fiji Airport on 10/5 at 12PM, arriving 10/1 at 10PM.
      $17,000
    - Limousine from Fiji Airport to Fiji Marina on 10/5 at 10PM, arriving 10/5 at 11PM.
      $500
    - Yacht from Fiji Marina to Paradise Pickles Private Island on 10/5 at 11PM, arriving 10/5 at 9AM.
      $12,000
    - Yacht from Paradise Pickles Private Island to Fiji Marina to on 10/19 at 9AM, arriving 10/19 at 5PM.
      $12,000
    - Limousine from Fiji Marina to Fiji Airport on 10/19 at 5PM, arriving 10/19 at 6PM.
      $500
    - Private Jet from Fiji Airport to San Diego Airport on 10/19 at 6PM, arriving 10/20 at 2AM.
      $23,000
    - Helicopter from San Diego Airport to Palace Pickles on 10/20 at 2AM, arriving 10/20 at 3AM.
      $5,000

- Thank you for using Premium Travel Services, luxury travel made simple.

Domain Diagram

After your analysis visit with Premium Travel Service, you sketch the following domain diagram. You feel great because that diagram was a lot of work and it's already behind you.



Technical Requirements from Premium's CTO

Premium's Chief Technology Officer, Jeff Adkisson, sent you some important requirements. The CTO's requirements are *not* domain-related but will significantly impact your *design and implementation*.

You tell him some of his requirements will be *pure fabrications*. He laughs and says "yeah, I read the Larman textbook as well. You're the first person I've ever met who used that term outside of a classroom. You really know your OO design and analysis. We've definitely hired the right person for the job."

The CTO's requirements include:

- Your application must be written in C# using Visual Studio or Java using Intellij. He likes those two languages and those two IDEs and will not test your work with anything else.

- All the application data must read from/written to disk using JSON. The CTO will award a bonus if the data can also be stored using XML with a quick change to a *configuration file*. Whether an XML persistence mechanism is included, the data storage provider must be interchangeable in compliance with the Liskov Substitution Principle, so he will be unhappy if JSON persistence is hardwired to the domain logic.

- The *minimum* requirement for the user interface is a console application. You can also build the UI using a C# or Java form. The CTO will award a ***large*** bonus *if* the user interface is implemented in a browser using either React or Angular because these days, the best apps all run on the web. The CTO does not care what web server you use, provided it follows the Model View Controller pattern.

- All UI flows begin with:
    - Start application and choose which Agent you are.
- UI flow #1 – create a new Trip (can be stopped at any point in process and resumed later)
    - Create a new Trip and auto-assign a unique ID
    - Add 1..* Travelers to trip (from existing Travelers list)
        - You will choose each Traveler from a list of Persons. Travelers must be unique within a Trip.
    - Add 1..* Packages to trip (from existing Packages list)
        - One Package includes a Travels From, a Travels To, a Price, and Hours of Travel. You will choose Travels From and Travels To from a list of existing Places.
    - Choose Payment By Person.
    - Choose Payment Type and collect appropriate details (card, check number, amount, etc.)
    - Payment must be equal to sum of Package.Price collection to become PaidInFull. If not PaidInFull, return to prior step.
    - Add 1 Payment to Trip.
    - Update Trip to add a required thank you note.
    - Show Itinerary.
- UI flow #2
    - List all trips owned by the Agent by status. Include the ID in each trip for use with UI flow #3.
        - Awaiting Travelers
        - Awaiting Packages
        - Awaiting Payment
        - Awaiting Thank You Note
        - Itinerary Ready
- UI flow #3
    - Continue working with an order using its ID.
    - If ID is invalid, return to prior step with warning.
    - If ID is valid:
        - If Trip is Awaiting Travelers, return to adding Travelers.
        - If Trip is Awaiting Packages, return to adding Packages.
        - If Trip is Awaiting Payment, return to adding Payment.
        - If Trip is Awaiting Thank You Note, return to adding Thank You Note.
        - If Trip is Itenerary Ready, display the Itinerary.

- Your code must demonstrate excellent SOLID and GRASP principles in addition to using standard GoF design patterns. Premium's business is growing rapidly, and the application must be extensible to meet new domain requirements. Following are the patterns the CTO *requires* you to include:
    - Strategy

        - To control persistence layer (JSON vs XML, *even if XML not implemented*)
    - Factory
        - To create subtypes of classes
    - Singleton
        - To pre-load People, Place, TravelAgent, TransportType, and PaymentType
    - Decorator
        - To build the Itinerary
    - State
        - Accepts a Trip and updates state to determine next step
        - Awaiting Travelers
        - Awaiting Packages
        - Awaiting Payment
        - Awaiting Thank You Note
        - Itinerary Ready

- Your code must use good naming conventions and be appropriately commented using XmlDoc (if C#) or JavaDoc (if Java).
  Here the CTO notes that "appropriately commented" means the comments are brief, explain the purpose of the class (if in the class header), and explain the code (where necessary to explain complex operations – nothing obvious like "the for loop iterates over the collection" – duh). The CTO wants your code to be as self-documenting as possible via the use of good names, but also knows some areas require inline comments. He reminds you that comments are for the people who come after you who must maintain and extend your code.

How to Test Your Final Application

The CTO will provide some sample data and test cases you will use to certify the application works properly when demoing your work to the CTO. One test case you can expect is to recreate the Poe Pickles itinerary from this document. It's up to you to get the sample into a format your application can read from a file. Getting the data into a usable format is frustrating, but how would your client know exactly how the application's data must be formatted? That sounds like a very specific implementation detail.

How You Get Payed (Graded)

Premium's CTO is also your executive sponsor and will pay you the following for various iterations of the project. Your "pay" for the complete project amounts to 40% of your total grade. In addition to the notes below, the CTO will provide a detailed grading rubric for each iteration to help you understand his expectations in advance.

- **20% - Iteration 1** – You get started by creating a use case diagram showing the big use cases and actors involved in the project. Next, you perform class design for *domain objects* and design a state machine that handles the process of creating a complete trip. In addition to the polished use case diagram, class diagram, and state machine diagram you must provide, you also write a one-page document describing your designs to convince the CTO you are ready to go to the next iteration. To get full payment for this iteration, the CTO requires your work to demonstrate that you thoroughly understand the domain model and how to implement the domain model. The CTO is your executive sponsor at Premium and if your work isn't great, he loses credibility at work.

- **20% - Iteration 2** – During iteration 1, you learned a lot about patterns. Next, you update your class design to include the various patterns you are implementing. You produce a very detailed class design that shows your pattern implementations and non-domain features such as persistence and UI mechanisms. Once again, you write a one-page document describing your designs to convince the CTO you are ready to go the next iteration. To get full payment for this iteration, the CTO requires your work to demonstrate that you are going to build something that exhibits excellent OO design principles, including SOLID, GRASP, and implements the GoF patterns he requires.

- **40% - Iteration 3** – Finally, you get to the fun part – coding your implementation. You code the entire solution, test it using the CTO's test data (plus your own), and really polished up the user interface. You send your implementation to the CTO along with a detailed document explaining how to compile the project, how to run it, and all details he needs to try it out *without asking you for help*. You really work hard on this bit because a lot of money is riding on the CTO's assessment of your work. To get paid for this iteration, the CTO expects your implementation to *compile easily and produce an itinerary for Mr. Pickles like the example*. You can expect the CTO to look at your code and step through it.
  IMPORTANT! Teams of 2 must implement the XML, Test Runner, and Doxygen components in Iteration 3. See below for details.

- **Iteration 3 - 5% Bonus for Team of 1** / **Required for Team of 2** – The CTO is not comfortable being locked into a single storage format. He loves JSON, but also knows XML is far from dead in the enterprise application space. The CTO will award a bonus if the data can also be stored using XML with a quick change to a configuration file, allowing Premium to store their data in XML *or* JSON.
  IMPORTANT! *For Teams of 2, this component is **mandatory**, not a bonus, and is part of Iteration 3's grade.*

- **Iteration 3 - 5% Bonus for Team of 1** / **Required for Team of 2**– The CTO is a big fan of test-driven development. He will pay extra if you automate testing using either NUnit (if C#) or JUnit (if Java). He knows you are terribly busy with other things and cannot load you down with so much stuff the project fails, but he firmly believes you get a performance boost and better code using automated testing, particularly early on before your UI works well.
  IMPORTANT! *For Teams of 2, this component is **mandatory**, not a bonus, and is part of Iteration 3's grade.*

- **Iteration 3 - 5% Bonus for Team of 1** / **Required for Team of 2** – The CTO has no life and enjoys reading API documentation online on his days off. He has already required that you write appropriate comments in your project, so you're halfway there getting this bonus. Using Doxygen, automatically generate an HTML site that helps developers navigate your project's API. Doxygen can work with both C# and Java projects.

IMPORTANT! *For Teams of 2, this component is **mandatory**, not a bonus, and is part of Iteration 3's grade.*

- **Iteration 3 - 10% Bonus** – The CTO is a *big fan* of open source projects and encourages you to share your designs and code on GitHub. He thinks it helps you build your portfolio to impress future clients – interviews are so much better when you have actual work to show. Further, it demonstrates you know a bit about source control – something so many CS graduates know little about, but employers really value. The CTO *sincerely* hopes you do a great job building a GitHub repo and readme.md that shows off your great designs. He fondly recalls a project he did in graduate school for Dr. Edward Jung's Theory of Computation class and passes along the GitHub repo link as an example:
  https://jadkisson.github.io/dfa/
  https://github.com/jadkisson/dfa

- **Iteration 3 - 10% Bonus** – The CTO thinks the web is even better than America Online. He will award a 10% bonus if the user interface is implemented in a browser using either React or Angular because these days, the best apps run on the web. The CTO does not care what web server you use, provided it follows the Model View Controller pattern and he doesn't have to install a million complex things on his computer to test your project.

- **20% - Iteration 4** – You are *very* proud of your work and look forward to presenting it to Premium Travel Services. All employees of Premium, including the CTO, are going to be present while you show a dazzling PowerPoint talking about your project and do a short demonstration. It's important your presentation and application look great to really impress the CTO and Premium's employees. Getting people excited about your work is the best way to get more work in the future. It's also how the CTO will decide how much you get paid for this iteration. As usual, the old CTO fondly remembers his graduate school days and sends you this bizarre online presentation he did for Dr. Mike Franklin's Operating Systems class:
  http://prezi.com/sfqxdrhc8ykn/?utm_campaign=share&utm_medium=copy&rc=ex0share

You think, "Wow – I can *really earn a lot on this* and make up for other things maybe I didn't get paid so much. With bonuses, I can add a lot of *bonuses* to my project grade *while learning cool stuff* I can show future clients and employers. Best project *ever*!" Some of your friends say, "aren't you too busy for all of those bonuses?" You laugh, but wisely decide to do a great job on the required pieces before getting caught up chasing cool bonus work.

Teams: Lone Wolf (Team of One) *or* Choose One Partner (Team of Two)

- Premium's CTO (and your instructor) recognizes some people like to work alone and other people like to work with a partner. The CTO does not mind if you do the entire project *alone* or with *one* partner.

- If you join a team of two, your project is a bit larger because you have more resources. For teams of two, iteration 3 has 3 additional components (XML storage, test-driven development, and DOxygen) that are *mandatory* and carry *no extra bonus*. The overall bonus potential for a team of two is not as high as a team of one, but you have more resources to achieve the big bonuses. This helps even the workload with students who are teams of one.

- If you are a team of two, you *and* your partner must schedule a meeting with your instructor (who is also the CTO) during office hours after iterations 1, 2, and 3 to discuss which parts each of you performed. Your instructor *will not* give each team member same score unless it's clear the work was evenly divided and both of you exhibit the same level of expertise with the iteration. You and your partner will also divide up presentation duties for iteration 4. Office hours are every Tuesday after lecture in the classroom. Choose a partner very carefully.

  When you mention you are considering a partner, the CTO starts talking about The Mythical Man Month, a so-called "classic" book (made of actual dead trees) he tries to press into your hands. He tells you adding team members adds management overhead to a project, can slow you down and even cause your project to fail. Perhaps your team members don't get their bits done and you must make up for them, they are not as adept or hardworking as you, or it is hard to coordinate who does what and get your code integrated together in time. You wonder how an IBM book written in 1974 (when the old-timer CTO was 4) about team size and software engineering could possibly be relevant today.... wasn't IBM the company with punch cards? You humor the old guy and promise to read it someday.

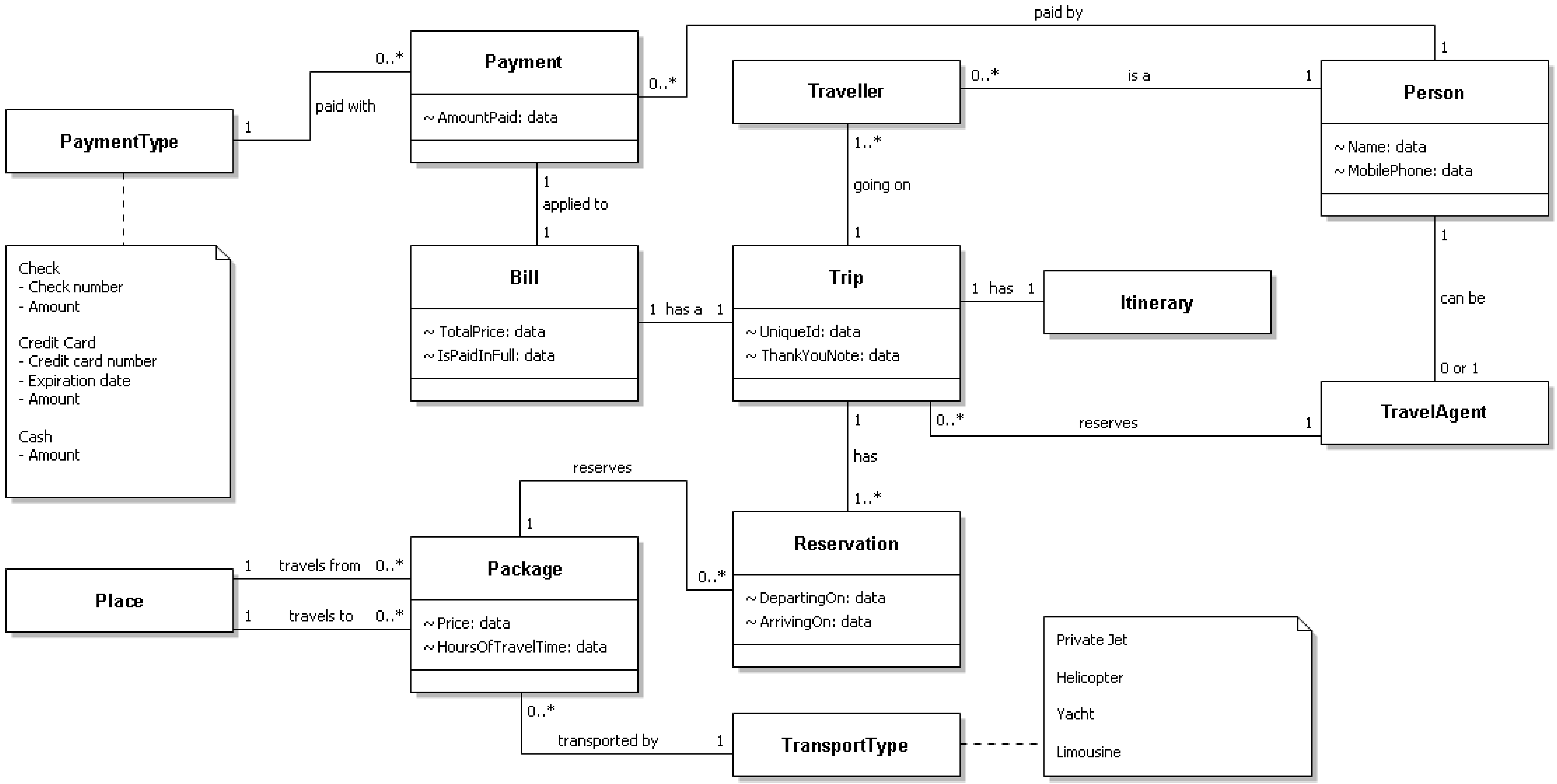
Tentative Project, Homework, & Exam Schedule (as of 9/30, subject to change)

- Tuesday, October 2nd
  Project introduced
- Thursday, October 4th
  Iteration 1 review
  JSON & XML serialization lecture
  Inform instructor whether team of 1 or team of 2
- Tuesday, October 23rd
  Iteration 1 due
  Iteration 2 review
- Tuesday, November 6th
  Iteration 2 due
  Iteration 3 review
- Tuesday, November 13th
  Iteration 4 review
  Draw number for presentation date
- Thursday, November 15th
  Exam 2
- November 17th – November 25th
  Fall Break
- Tuesday, November 27th
  Iterations 3 and 4 due
- Tuesday, November 27th and Thursday, November 29th
  Presentations (order randomly picked)
- Final Exam

There will also be two homework items to practice design patterns:

- *Homework 3 - between Iteration 1 and 2*
- *Homework 4 - between Iteration 2 and 3*

Domain Diagram for Reservation System



Payment
~ AmountPaid: data
PaymentType
paid with
1
0..*
Check
- Check number
- Amount
Credit Card
- Credit card number
- Expiration date
- Amount
Cash
- Amount
Bill
~ TotalPrice: data
~ IsPaidInFull: data
applied to
1
1
paid by
0..*
1
Traveller
Person
~ Name: data
~ MobilePhone: data
is a
0..*
1
going on
1..*
1
Trip
~ UniqueId: data
~ ThankYouNote: data
1 has a 1
1 has 1
Itinerary
can be
1
0 or 1
TravelAgent
reserves
0..*
1
has
1
1..*
Reservation
~ DepartingOn: data
~ ArrivingOn: data
reserves
1
0..*
Package
~ Price: data
~ HoursOfTravelTime: data
Place
1 travels from 0..*
1 travels to 0..*
transported by
0..*
1
TransportType
Private Jet
Helicopter
Yacht
Limousine