CSE 416, Section 1

Project Components

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Team Activities

Be active with Piazza

- Be sure to read the project description page on the class web site (link in the Links box)
  - Become familiar with the references that describe the measures in detail
  - Review the project deliverable calendar and note the next two (use case list and GUI prototype) that are due
- Identify the technical skills that your team will need to develop
- Start on a client/server prototype if you have not done a J2EE system before

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Session Objectives

- Understand data requirements
- Start to think about your GUI
- Understand options for accessing and processing currently available data
- Define the functions of the system

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Data Requirements

- 3 states
- Boundary data (e.g., precinct, congressional district)
- Demographic data (e.g., population, voting age population, population by racial/ethnic group)
- Election result data (not for required use cases)

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Preprocessing

- Goal – Do as much processing as possible in advance to lessen the server processing load
- Sample preprocessing tasks
  - Break out precinct boundary data if your data source groups it together
  - Determine precinct neighbors
  - Map some data identifiers to a canonical name (e.g., precinct name)
  - Combine multiple data sources (e.g., census) to generate complete precinct data
  - Write data to tables in your DB and to sequential files for use in the SeaWulf

Use a data source that has already done much of the preprocessing

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Precinct Graph Formation

- Goal – form the graph of all precincts
- Graph
  - Each precinct is a node in the graph
  - Physically adjacent precincts identify edges in the graph
- There may be some issues with the precision of the geometry
  (self-intersecting edges, gaps, etc.) – you can relax some precision as long as you can generate a reasonable graph of the precincts

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Precinct Adjacency Problem

- Complexity
  - Up to 25,000 precincts (polygons) in a state
  - Up to 50 edges (line segments) in a precinct boundary polygon
  - Up to 1.25M line segments (25,000 * 50)
  - Every pair of line segments can be compared to identify adjacency (up to 1.6T comparisons)

You will need to avoid n^2 comparisons by defining some limited set of search spaces

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Precinct Adjacency Approach

- Determine a "search space" to avoid the n^2 edge comparisons
- Identify the polygons in the search space
- For a given precinct (i.e., polygon), iterate through the other polygons in the search space
- Compare polygons using a library function for polygon adjacency
- Use a library function to determine minimum line adjacency (200 feet)

Some Python libraries will allow you to define tree structure bounding areas for search

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Data Combining

- Your precinct objects should contain
  - Precinct identifier / county identifier
  - Boundary data
  - Election results (if required for one of your use cases)
  - Demographic data (total population and voting age population)
- You might find multiple data sources with common precinct identifiers – combination will be easy
- You might need to get demographic data from US Census – combination will be more difficult

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Election and Demographic Data Issues

- Election results and demographic data originate from different sources (e.g., statewide tabulations and US Census Bureau)
- Census Bureau reports in various levels (blocks, groups, tracts, counties, and states), but possibly not precincts
- You need to identify a census block with a precinct, then accumulate demographic data into the precinct
- Average precinct is about 60 times larger than average census block
- Census Bureau attempts to coordinate with voting data through Voting Tabulation Districts (VTDs)

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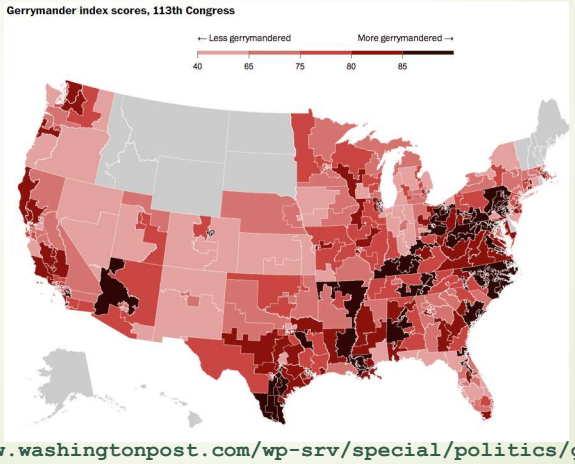
Web GUI

A prototype GUI is very helpful in driving out your requirements

Top-level page will likely be something like this



Be sure to use a mapping tool (e.g., Leaflet, Google Maps)

http://www.washingtonpost.com/wp-srv/special/politics/gerrymandering/

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User Input

- Think of all the information a user might input, and design a part of your GUI
- Most likely you will
  - Use tabs for input/results
  - Plan on AJAX for dynamic GUI updates

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OO Structure

- How do you identify the classes you need?
- How do you identify the attributes of each class?
- How do you determine the best type for an attribute?
- What is the best relationship among your classes

Remember to use encapsulation in your OO design

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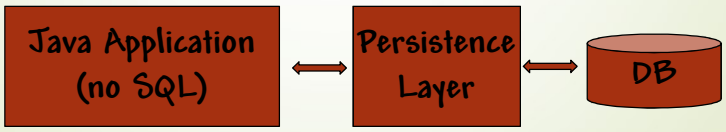
Persistence Layer

A major design issue is your DB, sequential files, and API access to existing data

- Your design will be object-first
- Database design will allow you to persist much of your OO data
- You will implement a layer (or use a tool) to
  - Retrieve DB data
  - Persist OO data

Requires OO-Relational mapping



JPA is helpful

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GeoJSON

- Open standard format for representing simple geometric features
- Based on JSON
- Types – Point, LineString, Polygon, MultiPolygon
- Supported by Leaflet, Google Maps, et al
- Position information expressed as longitude, latitude


```
{
"type":"FeatureCollection",
"name":"precincts",
"description":"Minnesota Congressional District 1
"title":"Minnesota Congressional District 1 Votin
"publisher":"Office of the Minnesota Secretary of
"date":"July 1,2019",
"features":[
{"type":"Feature","properties":{"Precinct":"Amboy
Earth","CountyID":"7","CongDist":"1","MNSenDist":
[[[-94.1585,43.8916],[-94.1651,43.8915],[-94.1651
[-94.1657,43.8879],[-94.1665,43.8879],[-94.1665,4
[-94.1664,43.8868],[-94.1664,43.8862],[-94.1582,4
[-94.1583,43.8856],[-94.1585,43.8856],[-94.1585,4
[-94.159,43.8848],[-94.159,43.8849],[-94.1585,43.
[-94.1577,43.8861],[-94.1575,43.8861],[-94.1575,4
[-94.157,43.8842],[-94.157,43.8843],[-94.1574,43.
[-94.1537,43.8828],[-94.153,43.8829],[-94.153,43.
[-94.1529,43.8862],[-94.1529,43.8867],[-94.153,43
[-94.1485,43.8903],[-94.157,43.8902],[-94.157,43.
[-94.153,43.8887],[-94.153,43.8884],[-94.1536,43.
{"type":"Feature","properties":{"Precinct":"Beauf
Earth","CountyID":"7","CongDist":"1","MNSenDist":
[[[-93.8884,44.0222],[-93.9085,44.0221],[-93.9286
[-94.0084,43.964],[-94.0084,43.9349],[-93.9685,43
```


Be alert for MultiPolygon data

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Shapefiles

- Geospatial vector data format
- Developed and maintained by ESRI
- Introduced in early 1990s
- Collection of files
  - Usually stored as a zip file
  - Mandatory files (.shp, .shx, and .dbf) and other files
- Represents points, lines, polygons
- Formatted as fixed length header, followed by one or more variable length records

Dominant format for geographic data due to the market dominance of ESRI

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Precinct Boundary and Voting Data

- Possible sources
  - Harvard Election Data Archive – link in project page
  - OpenElections
  - States (e.g., https://www.sos.state.mn.us/election-administration-campaigns/data-maps)

Sources of Data

13. The MIT Election Data Scie
14. The Harvard Election Data
15. The Public Mapping Project
16. The Open Elections Project
17. A githb repository that might
18. Partisan Gerrymandering Hist
19. US Supreme Court Blog for G
    Contains links to many docum

Within a state, the office of the Secretary of State is usually responsible to provide election data

Keep checking the project page for new suggestions on data sources

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Scope

Review the fall 2020 CSE416 use case list for style and scope

- Scope of the system is defined by your set of use cases
- A master set of use cases will be given to you following the requirements phase
- The list will include required use cases and optional use cases
- Use cases relating to standard system operation (e.g., change password) will not be in master use case list

Use cases are not a great fit for this project, but will be used as a way of normalizing units of work

There will likely be about 60-70 use cases, and you will have a target of 40 use cases

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Comments on Project Use Case List

- Project not a great fit for use cases since actor driven scenarios create many complex use cases
- List of use cases is a 2-step process
  - Teams develop their list of requested use cases
  - Recommendations of each team will be considered in the generation of a master list of about 60-70 use cases (you will complete about 40 of these)
- Use cases the for project will
  - Provide balanced units of work
  - Allow for final demo grading based on completed use cases
- Use cases will consist of required, preferred, and optional
- Project grading will emphasize required and preferred use cases

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How do You Assign Responsibilities to Team?

- Some parts of the project are standard SW development
- Major risk/unknown areas
  - What is the user interface? How do you display maps?
  - What data is associated with your requirements?
  - What are the best sources of that data?
  - How will you extract that data?
  - What analysis of the data is meaningful?
  - How do you test your system? To what do you compare your results?

Remember, the project is much more than just coding

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High Priority Project Tasks

- Understand terminology and concepts in problem domain (read background references)
- Search for data and think about a starting OO structure that includes the graph components
- Think about the components in your GUI, along with Ajax updates
- Build a simple system prototype to help understand SW design issues (especially client/server interface)

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Did You Achieve The Session Objectives?

- Understand data requirements
- Start to think about your GUI
- Understand options for accessing and processing currently available data
- Define the functions of the system