CS 134:
Tic Tac Toe (3)
TTTLetter & Game
Announcements & Logistics

- **HW 8** due tonight @ 10 pm
- No new HW this week
- **Lab 9 Boggle** starts today/tomorrow: Lab is decomposed into **three** logical parts
  - **Parts 1 & 2 (BoggleLetter & BoggleBoard)** due Wed/Thur 10 pm
  - We will run our tests on these and return automated feedback (similar to Lab 4 part 1), but you are allowed to revise it afterwards
  - **Parts 3 (BoggleGame)** due Nov 30/Dec 1
  - Please spend time planning and thinking about design with your partner before your lab session!

Do You Have Any Questions?
Last Time

• (Briefly) Looked at important helper methods in the Board class
• Discussed how to build the TTTBoard class
  • Added a grid of TTTLetters to the Board class
  • Discussed logic to check for win on TTTBoard
• Any questions?
Today’s Plan

• Finish our game! Woohoo!

• Implement TTTLetter
  • We already have a good sense of what it should do after our last class, but let’s look at the details

• Implement the game logic
  • Keep track of mouse clicks
  • Keep track of players ("X" and "O" alternate)

• Use methods in TTTLetter and TTTBoard to check for win after each move
TTTLetter Class
TTT Letters

- We have already seen a glimpse of what TTTLetters needs to do
- In fact it has to support this functionality for TTTBoard!

```python
class TTTLetter(builtins.object):
    TTTLetter(board, col=-1, row=-1, letter='')

    A TTT letter has several attributes that define it:
    * _row, _col coordinates indicate its position in the grid (ints)
    * _textObj denotes the Text object from the graphics module,
      which has attributes such as size, style, color, etc
      and supports methods such as getText(), setText() etc.
    * _rect denotes the Rectangle object from the graphics module,
      which has attributes such as color and supports methods such as
      getFillColor(), setFillColor() etc.

    Methods defined here:

    __init__(self, board, col=-1, row=-1, letter='')
        Initialize self. See help(type(self)) for accurate signature.

    __repr__(self)
        Return repr(self).

    __str__(self)
        Return str(self).

    getLetter(self)
        Returns letter (text of type str) associated with self._textObj

    setLetter(self, char)
```
TTTLetter: __init__

• Let’s think about __init__ first

• A TTTLetter is just a “wrapper” around a Text object

• Using passed-in parameters (col, row, letter), to initialize __slots__ attributes

```python
from graphics import *

class TTTLetter:
    __slots__ = ['_row', '_col', '_textObj']

    def __init__(self, win, col=-1, row=-1, letter=' '):
        # global variables needed for graphical testing
        xInset = 50; yInset = 50; size = 50

        # set row and column attributes
        self._col = col
        self._row = row

        self._textObj = Text(Point(xInset + size * col + size / 2,
                          yInset + size * row + size / 2), letter)

        self._textObj.setSize(20)
        self._textObj.setStyle("bold")
        self._textObj.setTextColor("black")
        self._textObj.draw(win)
```
**TTTLetter: Getters, Setters, __str__**

- Now let’s implement the necessary getter/setter methods
  - We don’t need/want to expose the Text object
  - We don’t want to allow the row, col to be changed
  - We only expose the string (letter) of the Text object, so they are the only getter/setter methods we need
  - __str__ useful for debugging and testing

```python
def getLetter(self):
    return self._textObj.getText()

def setLetter(self, char):
    self._textObj.setText(char)
    if char == 'X':
        self._rect.setFillColor("light blue")
    elif char == 'O':
        self._rect.setFillColor("pink")
    else:
        self._rect.setFillColor("white")

def __str__(self):
    l, col, row = self.getLetter(), self._col, self._row
    return "{} at Board position ({{}}, {{}})".format(l, col, row)
```
Testing TTTLetter

- It’s always a good idea to test our class and methods in isolation
- Note: No Board involved!

```python
win = GraphWin("Tic Tac Toe", 400, 400)
letter = TTTLetter(board, 1, 1, "X")
letter2 = TTTLetter(board, 1, 2, "O")
letter3 = TTTLetter(board, 2, 1, "X")

letter2.setLetter("T")
print(letter2)

# pause and wait for mouse click
# this keeps the window open
point = win.getMouse()

T at Board position (1, 2)
```
TTT Game Logic

Game

TTTLetter

TTTBoard

Board
Finally... TTT Game Logic

- Let’s create a TTT flowchart to help us think through the state of the game at various stages

Let’s think about the “common” case: a valid move in the middle of the game
Finally... TTT Game Logic

- Let's create a TTT flowchart to help us think through the state of the game at various stages

Now let's consider the case of a win, draw, or invalid move
Finally… TTT Game Logic

- Let’s create a TTT flowchart to help us think through the state of the game at various stages.

Now’s let suppose a player chooses reset.
Finally… TTT Game Logic

- Let’s create a TTT flowchart to help us think through the state of the game at various stages

```
Start → Wait for mouse click
         ↓
         |   Grid? Y
         |   Empty space? Y
         |   Win? Y
         |   Reset state
         |   Y
         |   Draw? Y
         |   Change players
         |   N
         |   Exit? Y
         |   End
         N
         |   Reset state
         |   Y
         |   Reset? Y
         |   Exit? Y
         |   End
         N
         |   Exit? Y
         |   End
         N
```

Now’s let suppose a player chooses exit
Finally... TTT Game Logic

- Let's create a TTT flowchart to help us think through the state of the game at various stages.

Finally, let's handle the click that may be outside of any of the “valid” regions.
Finally… TTT Game Logic

- Let’s create a TTT flowchart to help us think through the state of the game at various stages
Translating our Logic to Code

Let's think about `__init__`:

- What do we need?
  - a board, player, and maybe `numMoves` (to detect draws easily)

```python
from graphics import GraphWin
from tttboard import TTTBoard
from tttletter import TTTLetter

class TTTGame:
    __slots__ = ["_board", "_numMoves", "_player"]

    def __init__(self, win):
        self._board = TTTBoard(win)
        self._numMoves = 0
        self._player = "X"
```

Start

- Wait for mouse click

- Grid?
  - Y: Empty?
    - Y: Win?
      - Y: Reset state
      - N: Draw?
        - Y: Change players
        - N: Exit?
          - Y: End
          - N: Reset state
  - N: Reset state

- Exit?
  - Y: End
  - N: Start
Translating our Logic to Code

- Now let's write a method for handing a single mouse click (point)
- We need a few if-elif-else checks to handle the grid/reset/exit check
- Let's start with that logic and fill the rest in later

```python
def doOneClick(self, point):
    # Start
    # Wait for mouse click
    # Grid?
    # Empty?
    # Win?
    # Reset state
    # Draw?
    # Change players
    # End
    # step 1: check for exit button
    # and exit (return False)
    if self._board.inExit(point):
        # end of code
    # step 2: check for reset button
    # and reset game
    elif self._board.inReset(point):
        # end of code
    # step 3: check if click is on a
    # cell in the grid
    elif self._board.inGrid(point):
        # end of code
    # keep going!
    return True
```
Translating our Logic to Code

- Let's handle the “exit” button first (since it's the easiest)

```python
# step 1: check for exit button and exit (return False)
if self._board.inExit(point):
    # game over
    return False
```
Now let's handle reset

```python
# step 2: check for reset button and reset game
elif self._board.inReset(point):
    self._board.reset()
    self._board.setStringToUpperText(""")
    self._numMoves = 0
    self._player = "X"
```
Finally, let’s handle a “normal” move. Start by getting point and TTTLetter

```python
# step 3: check if click is on a cell in the grid
elif self._board.inGrid(point):
    # get the letter at the point the user clicked
    tlet = self._board.getTTTLetterAtPoint(point)
```

Translating our Logic to Code

- Start
- Wait for mouse click
- Grid? N: Reset state
- Draw? N: Exit? Y: End
- Exit? N: Start
The rest of our code checks for a valid move, a win, a draw, and updates state accordingly.

At the end, if the move was valid, we swap players.

```python
# make sure this square is vacant
if tlet.getLetter() == "":
    tlet.setLetter(self._player)

# valid move, so increment numMoves
self._numMoves += 1

# check for win or draw
winFlag = self._board.checkForWin(self._player)
if winFlag:
    self._board.setStringToUpperText(self._player + " WINS!")
elif self._numMoves == 9:
    self._board.setStringToUpperText("DRAW!")
else:
    # set player to X or 0
    if self._player == "X":
        self._player = "0"
    else:
        self._player = "X"
```
TTT Summary

• Basic strategy
  • **Board**: start general, don’t think about game specific details
  • **TTTBoard**: extend generic board with TTT specific features
    • Inherit everything, update attributes/methods as needed
  • **TTTLetter**: isolate functionality of a single **TTTLetter** on board
    • Think about what features are necessary/helpful in other classes
  • **TTTGame**: think through logic conceptually before writing any code
    • Translate logic into code carefully, testing along the way
Boggle Strategies

• At a high level, Tic Tac Toe and Boggle have a lot in common, but the game state of Boggle is more complicated

• In Lab 9 you should follow a similar strategy to what we did with TTT

• Don’t forget the bigger picture as you implement individual methods

• Think holistically about how the objects/classes work together

• Isolate functionality and test often (use `__str__` to print values as needed)

• Discuss logic with partner/instructor before writing any code

• Worry about common cases first, but don’t forget the “edge” cases

• Come see instructors/TAs for clarification

GOOD LUCK and HAVE FUN!
The end!
Lab 9 Overview

• **User-defined Types with Inheritance!**
  • Using the Board class from...class

• Multi-week partners lab (counts as two labs in terms of grade; Lab is decomposed into three logical parts)
  • **Parts 1 & 2 (BoggleLetter & BoggleBoard)** due Nov 16/17
  • We will run our tests on these and return automated feedback (similar to Lab 4 part 1); you are allowed/encouraged to revise it afterwards
  • **Parts 3 (BoggleGame)** (and revised Parts 1 and 2) due Nov 30/Dec 1
Boggle Strategies

- At a high level, Tic Tac Toe and Boggle have a lot in common, but the game state of Boggle is more complicated.
- In Lab 9 you should follow a similar strategy to what we did with TTT.
- *Don’t forget the bigger picture as you implement individual methods.*
- Think holistically about how the objects/classes work together.
- Isolate functionality and test often (use `__str__` to print values as needed).
- *Discuss logic with partner/instructor before writing any code.*
- Worry about common cases first, but don’t forget the “edge” cases.
- Come see instructors/TAs for clarification.

GOOD LUCK and HAVE FUN!
Working with a Partner

- "Pair Programming" (or programming with a partner) is an Agile software development technique from Extreme Programming
  - It's used in the real world!
  - Produces better solutions than produced individually!
  - Spreads knowledge!
- It's good to be able to talk through complex ideas with someone else before diving into implementation details
  - Benefit from both partners' knowledge of problem-solving & debugging
**Git with a Partner**

**Pair Programming:** One person "drives", take turns who uses keyboard/mouse.

Discuss your design ideas with your partner!!
Identify bugs & bug fixes together!
git with a Partner

Jigsaw Programming:
Two partners, two different Python files!

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If an editor opens up saying files were merged: that's okay, just save & exit ("Ctrl+x" and then "y")

Discuss your design ideas with your partner!!
Identify bugs & bug fixes together!
git with a Partner

**DO:** Talk to your partner *a lot!*

**DO NOT WORK ON THE SAME FILE AT THE SAME TIME!**

There will be frustration!

And suffering!

And Lida will probably have to save you!
Git Reminders

- If machine doesn't have the repo, `git clone` the repo
  - Grab URL from https://evolene.cs.williams.edu/ (or Lida's email)
  - `git clone <URL HERE>`

- `git add/commit/push` frequently, as you get work done

- To grab your partner's edits, `git pull`
  - (if you've already `git cloned` the repo)
  - If you have not `git cloned` the repo, then `git clone`
Git Workflow Reminder

• Starting a work session:
  • Always pull most recent version before making any edits (clone if using a new machine)

• Middle of a work session:
  • Commit changes to all files first (git commit -am "message") commits changes to all files already on evolene
  • After commit, pull again to get your partner's edits
  • If an editor opens up saying files were merged: that's okay, just save & exit ("Ctrl+x" and then "y")
  • Then push your edits to evolene (can check evolene to make sure it worked)

• Do the above steps (commit, pull, push) frequently
• Can check status anytime by typing git status
• Let us know if you face any issues!

Do You Have Any Questions?