DRAGONFLY WINGS IN-CLASS LECTURE

OVERVIEW:
+ Do about 1 week in, after students have done tutorial
+ Post AFTER class

GOAL: help implement Project

BUT ALSO --> Practical issues with real-time, distributed state simulation! (i.e., also CLASS MATERIAL)

0) ASSUME

Tutorial done

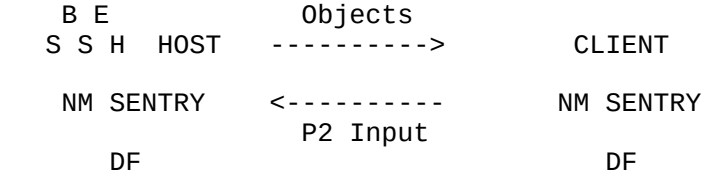
-- Worked through! Not just compilied game-final.zip

Networking is complete and debugged

-- NetworkManager, EventNetwork and Sentry

-- Tested! Be sure to test thoroughly before proceeding!

1) PICTURE



2) QUESTION - why is synchronization needed? If each PC runs the exact same simulation, no need to synchronize!

- This means exact same random seed, too!

NOTE: Random number generation is complex function. e.g.,

```
// Generate "random" number.
int rand()
  g_next = ((5 * g_next) + 1) mod 16

// "Seed"
void srand(int seed)
  g_next = seed
```

e.g., Host picks from rand() - 32, 12, 10, 64 ...
Client picks from rand() - 32, 12, 10, 64 ...

But if Objects processed in slightly different order (e.g., Saucer 1 before Saucer 2), will be off!

- User input adds variability -> takes time to propogate to other host

Even if Objects stored in same order, latency from event (e.g., user input) could mean additional random number drawn --> will be off!

--> Will be out of sync during travel (and could be some effect)

- So *cannot* be done at the exact same time

= Could apply "timestamp" and either:

+ Delay user action - would feel like lag. How long to delay?

+ Roll back Host state (time warp) - complicated and change what host sees

3) THEREFORE -> HOST is authoritative.

-- Has the final say of the world.

-- CLIENT will simulate as much as possible, but HOST is responsible for "important" decisions (e.g., is Hero hit by Saucer?)

(Note: has side benefit of helping prevent cheating by CLIENT)

4) QUESTION: What player input commands does CLIENT send?

KEY - for keystrokes
MOUSE - for when mouse is clicked

Note: Do *not* need to send when Mouse is moved. Do not need to show opponent's RETICLE.

KEY includes keypressed and MOUSE includes (x,y)

Note: Client can check for valid key before sending (e.g., no need to send non-recognized keystroke)

5) QUESTION: What object commands does HOST send?

NEW - whenever a new object is created
UPDATE - whenever an existing object has changed
DELETE - whenever an object is destroyed

Each includes Object ID, and UPDATE and DELETE includes serialized attributes

e.g., CLIENT receives DELETE

```
df::WorldManager &world_manager = df::WorldManager::getInstance();
Object *p_obj;
p_obj = world_manager.objectWithId(id);
if (p_obj == NULL)
   // error! not found
world_manager.markForDelete(p_obj);
```

6) QUESTION: What are all the game Objects for Saucer Shoot 2?

Bullet
Explosion
Hero
Points
Saucer
Score
Stars
GameStart (not required)

```
  Nuke Display (not required)
  GameOver (not required)


7) QUESTION: Do all need to be synchronized?


STARS --> QUESTION: does it matter if they deviated in location/speed?

 -- Could send NEW when HOST creates

 -- Could have both HOST and CLIENT create their own "set" upon startup


SAUCER

 -- Position matters --> send NEW

 -- Client and Host can both do velocity (no need to update position)

 -- QUESTION: when would they deviate?

    ANSWER: when "respawns" in random location off to right --> UPDATE

 -- QUESTION: what about animations?

    ANSWER: never need to synchronize (a "decoration")


COLLISION

 -- Both Client and Host can simulate collision

 -- But Host needs to officially determine outcome (authoritative)

 -- Destroy Bullet and Saucer --> DELETE

    QUESTION: What about EXPLOSION?

    -- Could create on Host and send NEW .... QUESTION: or ...?

    -- Host and Client both create when Saucer dies (saves bwidth)


HERO

 -- Does not have velocity

 -- When Player 1 key --> Host moves --> UPDATE

 -- When Player 2 key --> Client could move --> UPDATE to Host

    QUESTION: But what if move was invalid (e.g., Saucer there or Hero there)?

    ANSWER: Host would tell Client, and Client "rollback" / "fix" --> BLEAH

    QUESTION: So, why would a system ever do that?

    ANSWER: Avoid LAG.  Basically, otherwise at least 1 RTT for response

 -- SO, when Player 2 key

    --> Client sends KEY
```

```
    --> Host applies --> UPDATE

RETICLE
 -- QUESTION: Does opponent care where this is?  Probably not.
    --> Don't syncrhonize
 -- Host mouse click --> new Bullet --> NEW
 -- Client mouse click
    --> send MOUSE (x,y)
    --> Host receives, creates Bullet --> NEW
 -- NOTE: can do "smart" checking on Client
    e.g., when click, is too soon to spawn --> if so, no need to send
    BUT -> Host will still need to check, too --> avoid CHEAT

POINTS
 -- When change value --> UPDATE
 -- Could do "time" / "ticks" locally, so only UPDATE when Saucer destroy

8) QUESTION: How to "detect" changes in HOST?
  Host poll all Objects every step
  Could just serialize() every object
   --> remember, only sends changes since last serialize()
  QUESTION: why not?
  ANSWER: even "decoration" changes serialized
   --> e.g., animation

  So, check specific attributes --> isModified()
   --> e.g., isModified(df::POS)
  Send as appropriate
  TIP: Make function, bool needSynch(Object *p) --> TRUE if synch, else FALSE

  // Bullet synchronized when created
  if (p_o->getType() == "Bullet-Host" || p_o->getType() == "Bullet-Client") {
    if (p_o->isModified(df::ID))
      return true;
    return false;
  }

  // Hero synchronized when moves or is created.   SHOW DIFF ONLY
```

```
  if (p_o->getType() == "Hero-Host" || p_o->getType() == "Hero-Client") {
    if (p_o->isModified(df::ID) ||
        p_o->isModified(df::POS))
      return true;
    return false;
  }

  ...

  NOTE -> SAUCER (additional force synch in move-to-start)

  // Saucer only synchronized when created.
  // Movement handled locally (synchronized again in moveToStart()).
  if (p_o->getType() == "Saucer") {
    if (p_o->isModified(df::ID))
      return true;
    return false;
  }


  USE IT!!

  // Only send objects needing synchronization.
  df::ObjectList all_objects = world_manager.getAllObjects();
  df::ObjectListIterator i(&all_objects);
  for (i.first(); !i.isDone(); i.next()) {

  if (needSynch(p_o)) {

    // Set message type.
    // If object id is modified, assume NEW
    HostMessageType msg_type;
    if (p_temp_o->isModified(df::ID))
      msg_type = ADD_OBJECT;
    else
      msg_type = UPDATE_OBJECT;

    sendObject(p_temp_o, msg_type);

  }


9) NOTE - needs player-versions of some objects

 -- HOST-HERO and CLIENT-HERO.  QUESTION: Others?

    -- Bullets (color and who gets points)

    -- Points

 -- Could make separate Object, but duplicate a lot of code.

    QUESTION: Alternative?

 -- Could create "bool is_host" funcationality.  Act appropriately.

    Hero get keyboard input

    if isHost()
       // apply to Host-Hero
    else
       // send to Host
    end if
```

Use ROLE singleton (see slides/writeup)

10) REMEMBER Saucer Shoot 2 only needs

Core gameplay

Does not need:

- GameStart
- Nuke Display
- GameOver

HOST starts - waits for CLIENT

CLIENT connects

--> Start moving and shooting!

When either/both die

--> Game exits (gracefully)

NOTE: Can add extras for 5% Misc points

-- If so, Subtle - GameStart is "inactive()" --> getAllObjects(true)

HAPPY SHOOTING!