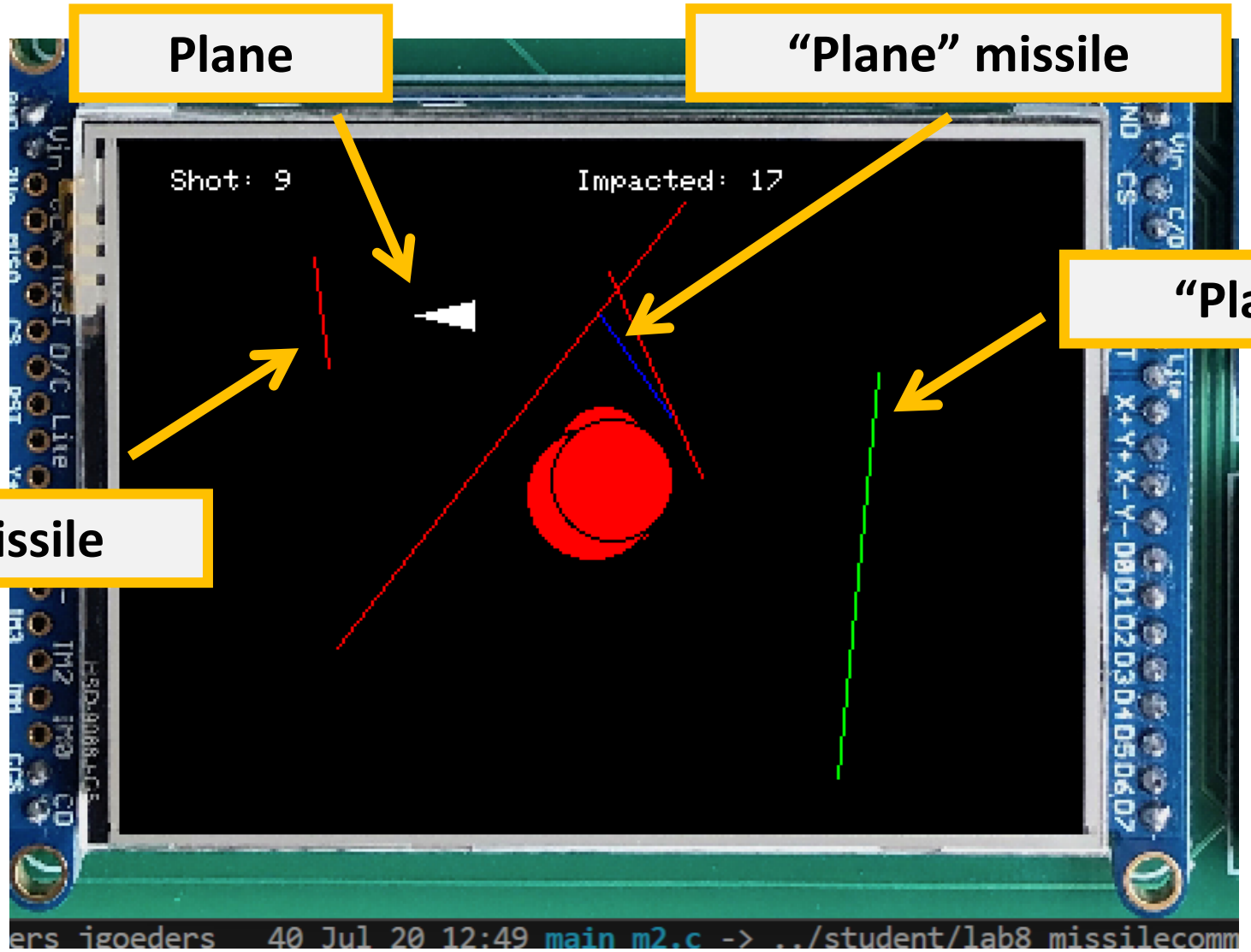
Missile Command

ECEN 330

BYU Electrical & Computer Engineering
IRA A. FULTON COLLEGE OF ENGINEERING


Plane
“Plane” missile
“Player” missile
“Enemy” missile
Shot: 9
Impacted: 17

Milestone 1: Missiles

Every missile is its own state machine!

- Keep track of the missile current state and other properties in a struct

Tick function will accept a pointer to a missile struct:

```
void missile_tick(missile_t *missile);
```

Multiple different init functions depending on missile type:

- `missile_init_enemy(missile_t *missile,..)`
- `missile_init_player(missile_t *missile,..)`
- `missile_init_plane(missile_t *missile,..)`
- `missile_init_dead(missile_t *missile,..)`

```c
/* This struct contains all information about a missile */
typedef struct {

    // Missle type (player, enemy, enemy plane)
    missile_type_t type;

    // Current state (the 'enum' will be defined in your missile.c file, so it's
    // just declared as an integer type here)
    int32_t currentState;

    // Starting x,y of missile
    uint16_t x_origin;
    uint16_t y_origin;

    // Ending x,y of missile, and the total length from origin to destination.
    uint16_t x_dest;
    uint16_t y_dest;
    uint16_t total_length;

    // Used to track the current x,y of missile
    int16_t x_current;
    int16_t y_current;

    // While flying, this tracks the current length of the flight path
    uint16_t length;

    // While flying, this flag is used to indicate the missile should be detonated
    bool explode_me;

    // While exploding, this tracks the current radius
    double radius;

    // Used for game statistics, this tracks whether the missile impacted the
    // ground.
    bool impacted;

} missile_t;
```

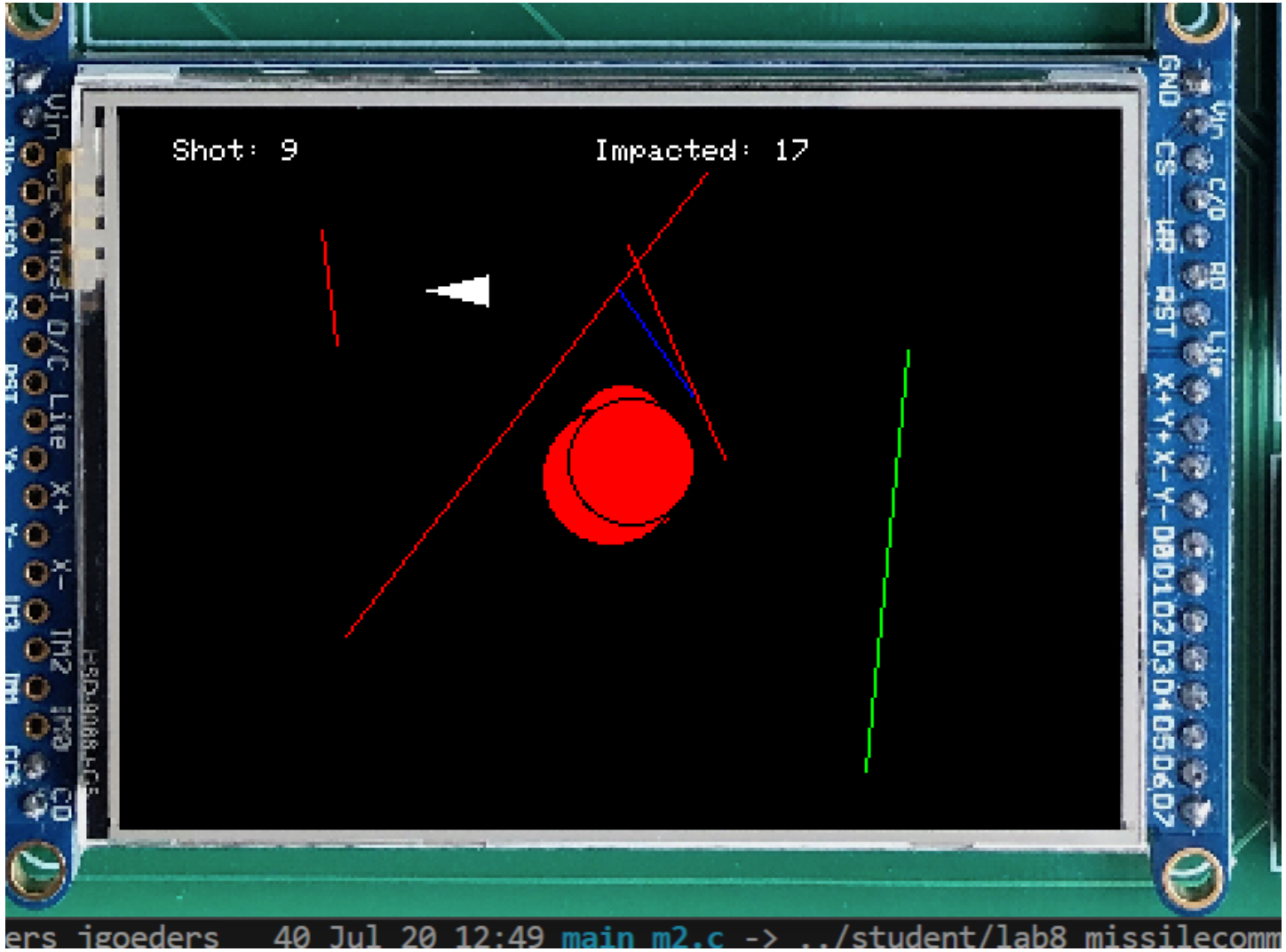
Missile Properties (struct members)

`type`

- Player, Enemy or Plane
  - Green, Red or Blue

`currentState`

- You get to make your own state machine for the missiles.
- I made states for:
  - Initializing
  - Moving
  - Exploding Growing
  - Exploding Shrinking
  - Dead



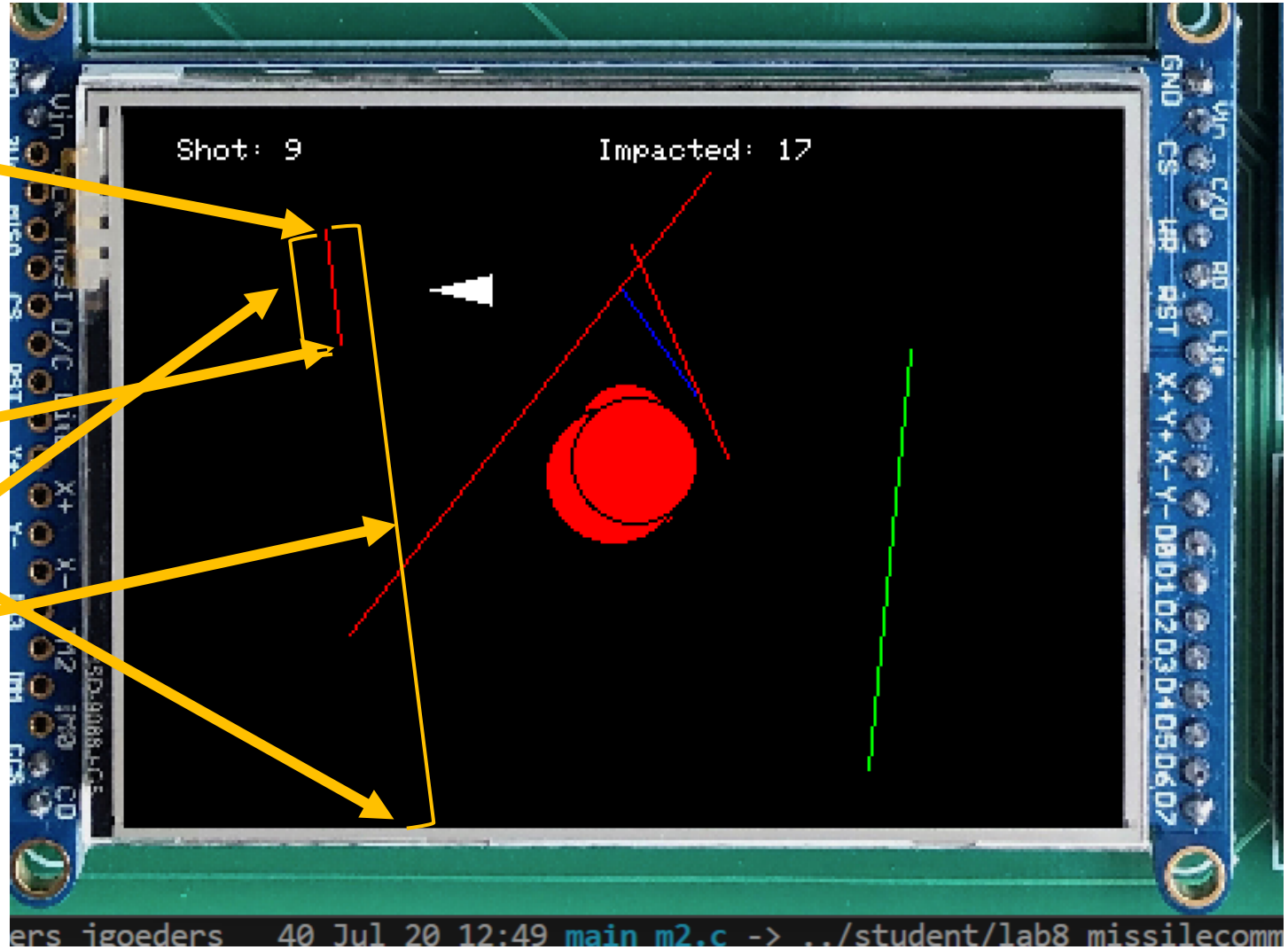
x_origin
y_origin

x_dest
y_dest

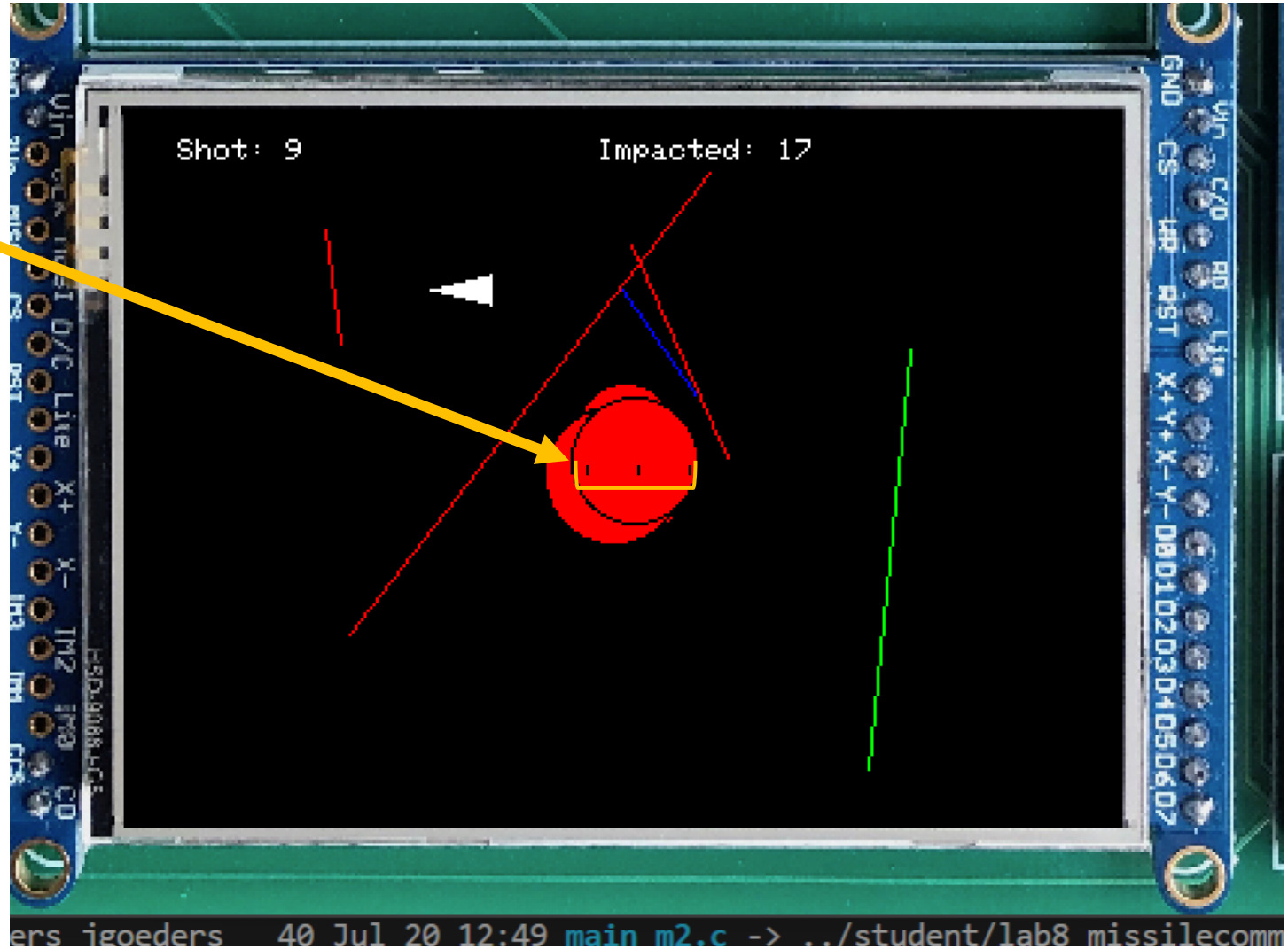
x_current
y_current

total_length

length



radius


Shot: 9
Impacted: 17
ers jgoeders 40 Jul 20 12:49 main m2.c -> ../student/lab8 missilecomm

Initializing Enemy Missiles

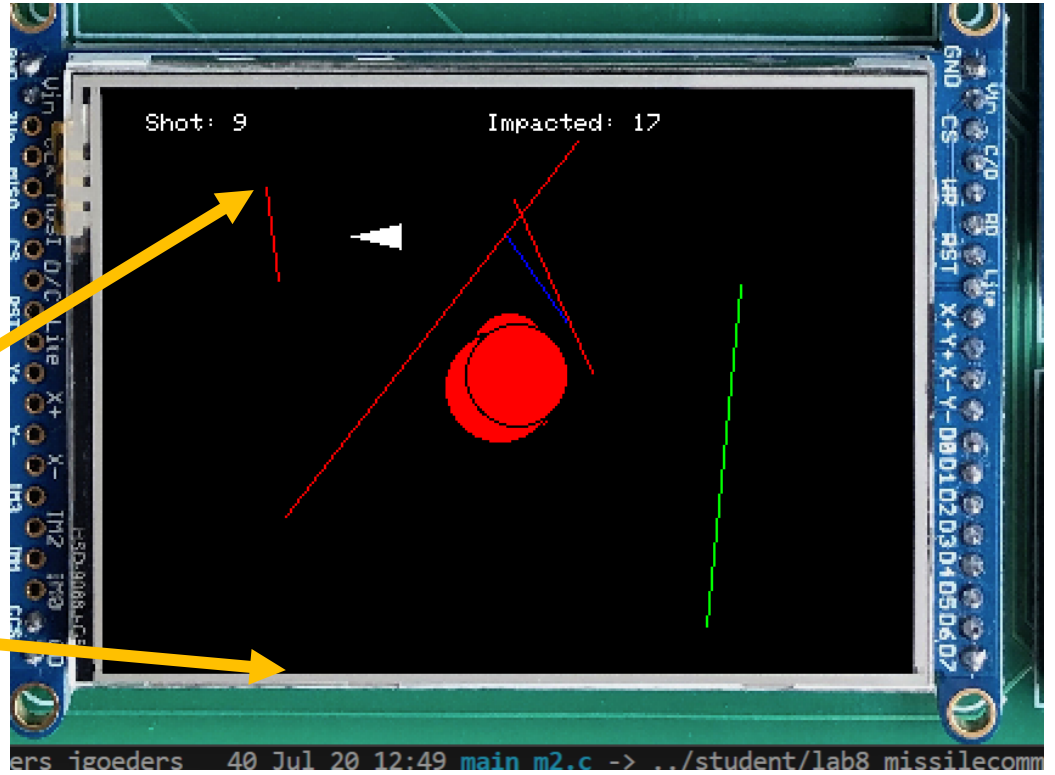

```
#define CONFIG_MAX_ENEMY_MISSILES 7
```

```
void missile_init_enemy(missile_t *missile) {
  missile->type = MISSILE_TYPE_ENEMY;

  // Set x,y origin to random place near the top
  // of the screen (top quarter? – you choose!)

  // Set x,y destination to random location along
  // the bottom of the screen

  // Set current state
}
```



Initializing Player Missiles


```
#define CONFIG_MAX_PLAYER_MISSILES 4
```

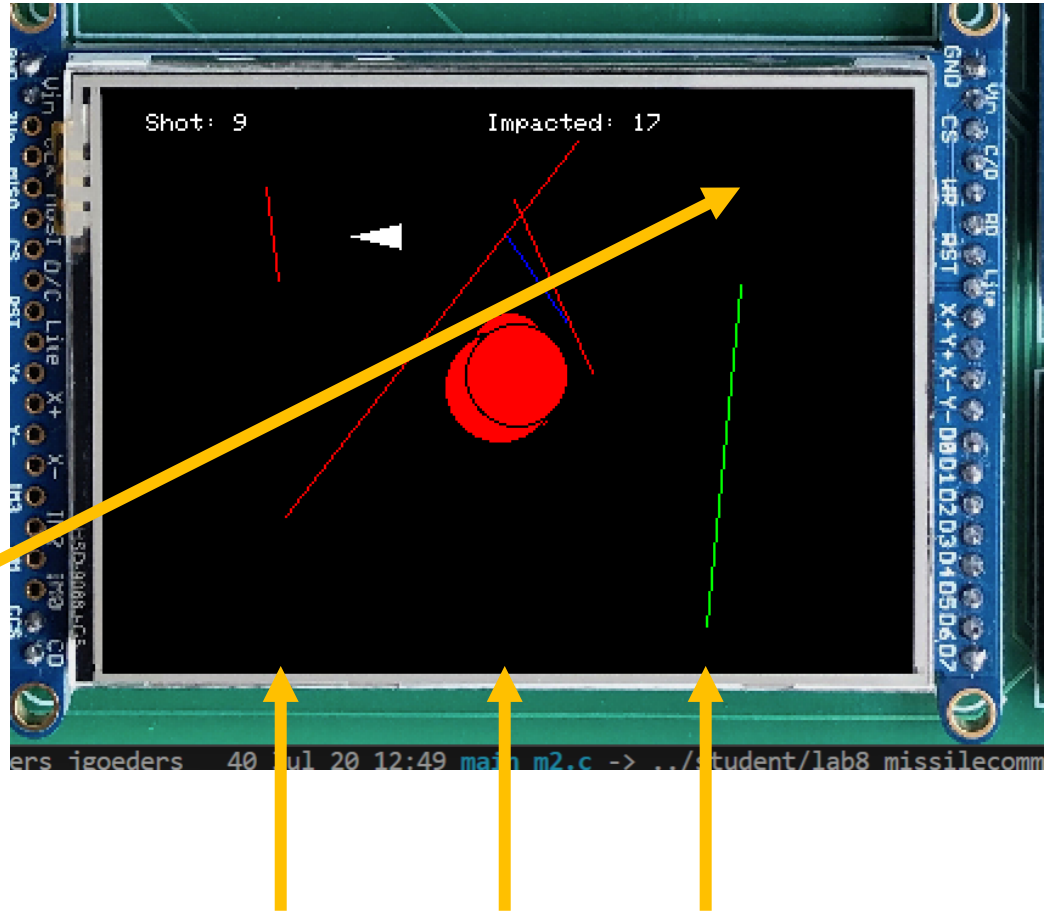
```
void missile_init_player(missile_t *missile, uint16_t
x_dest, uint16_t y_dest) {

  missile->type = MISSILE_TYPE_PLAYER;

  // Set x,y origin to closest missile launch site

  // x,y destination is provided (touched location)

  // Set current state
}
```



Missile launch sites (not drawn)
3 sites spaced evenly on display

Initializing Plane Missile (M3)


```
#define CONFIG_MAX_PLANE_MISSILES 1
```

You can assume this will never change

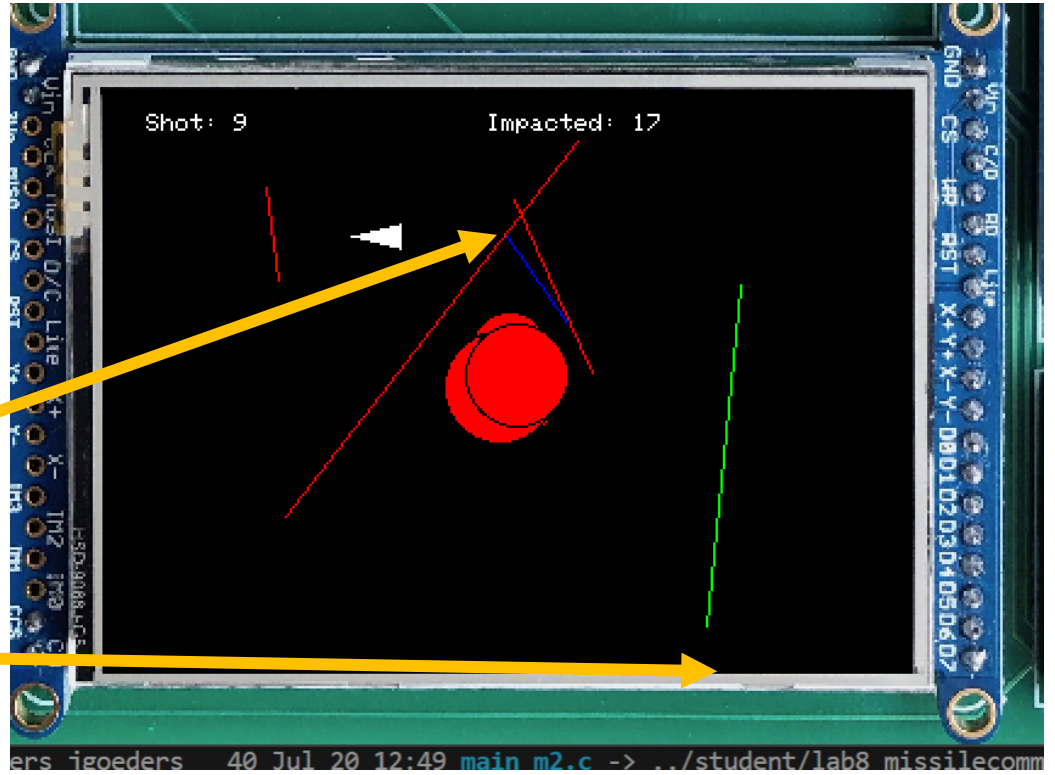
```
void missile_init_plane(missile_t *missile, int16_t
plane_x, int16_t plane_y) {

  missile->type = MISSILE_TYPE_PLANE;

  // x,y origin provided (plane location)

  // x,y destination chosen randomly along the bottom

  // Set current state
}
```



Ticking

What should you do in your tick function?

If the missile is flying:

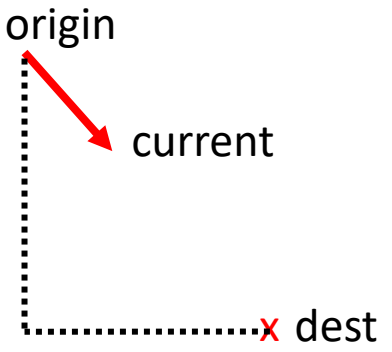
- Erase the old missile line
- Update length

```
// Speed of enemby missile
#define CONFIG_ENEMY_MISSILE_DISTANCE_PER_SECOND 40
#define CONFIG_ENEMY_MISSILE_DISTANCE_PER_TICK                          \
  (CONFIG_ENEMY_MISSILE_DISTANCE_PER_SECOND * CONFIG_TIMER_PERIOD)

// Speed of player missile
#define CONFIG_PLAYER_MISSILE_DISTANCE_PER_SECOND 350
#define CONFIG_PLAYER_MISSILE_DISTANCE_PER_TICK                         \
  (CONFIG_PLAYER_MISSILE_DISTANCE_PER_SECOND * CONFIG_TIMER_PERIOD)

// How fast explosion radius increases/decreases per second
#define CONFIG_EXPLOSION_RADIUS_CHANGE_PER_SECOND 30
#define CONFIG_EXPLOSION_RADIUS_CHANGE_PER_TICK                         \
  (CONFIG_EXPLOSION_RADIUS_CHANGE_PER_SECOND * CONFIG_TIMER_PERIOD)
```

- Calculate new current x,y
  - Calculate ***percentage*** of path traveled:
    - length / total_length
- Draw the new missile line



x_current = x_origin + percentage * (x_dest – x_origin)

Initializing other fields

For all missile types, you need to initialize:

- length = 0
- explode_me = false
- total_length = $\sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$ (Use sqrt function from <math.h>)
- x_current = x_origin
- y_current = y_origin
- impacted = false

- Probably best not to copy the same code to every init function, so you can:
  - Create a helper function
  - Or, do this in an INIT state of your state machine

Ticking

What should you do in your tick function?

If the missile is exploding (increasing):

- Increase radius
- Draw circle

```
// Speed of enemby missile
#define CONFIG_ENEMY_MISSILE_DISTANCE_PER_SECOND 40
#define CONFIG_ENEMY_MISSILE_DISTANCE_PER_TICK                          \
  (CONFIG_ENEMY_MISSILE_DISTANCE_PER_SECOND * CONFIG_TIMER_PERIOD)

// Speed of player missile
#define CONFIG_PLAYER_MISSILE_DISTANCE_PER_SECOND 350
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// How fast explosion radius increases/decreases per second
#define CONFIG_EXPLOSION_RADIUS_CHANGE_PER_SECOND 30
#define CONFIG_EXPLOSION_RADIUS_CHANGE_PER_TICK                         \
  (CONFIG_EXPLOSION_RADIUS_CHANGE_PER_SECOND * CONFIG_TIMER_PERIOD)
```

If the missile is exploding (decreasing):

- Erase circle
- Decrease radius
- Draw circle

Milestone 2: Game Control

In this milestone you will use your missiles to implement a basic version of the game.

gameControl.c:

- init()
- tick()

Need to handle:

- Launching enemy missiles (automatically)
- Launching player missiles (when screen touched)
- Detecting “collisions” and triggering explosions

First check out main_m1.c. It provided a very basic game control.

Game Control

Needs to keep an array of missile structs.

- You could use one big array, or separate arrays per type.

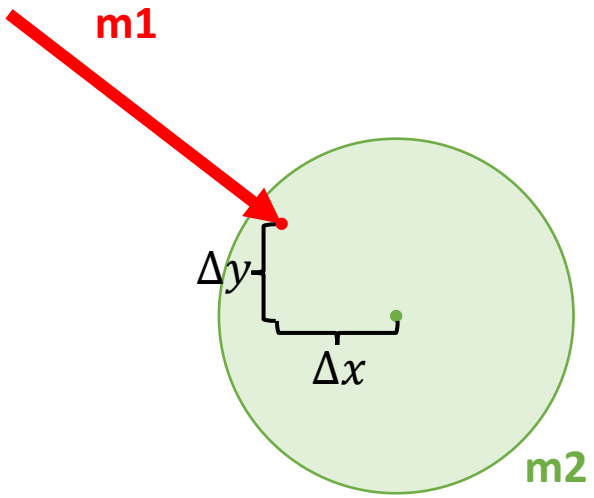
gameControl_init()

- Initialize all of your missiles

gameControl_tick()

- Tick all of your missiles
- If enemy missile is dead, relaunch it (call init again)
- If touchscreen touched, launch player missile (if one is available)
- Detect collisions

Detecting Collisions



Check if m1 is inside m2:

$$\Delta y^2 + \Delta x^2 < radius^2$$

- Any explosion type blows up enemy/plane missile
- Player missiles only explode when they reach their destination.

How to trigger an explosion?

- Set the `explode_me` struct member to true, and make sure your state machine checks this while the missile is flying.

Tick Time Issues

You may not have enough time to tick all of your missiles!

- Take a while to draw/erase explosions.
- If lots of things are exploding you will miss interrupts and the game will slow down

What could you do?

Tick half of the missiles each gameControl_tick().

- If you are ticking half as often, make sure you move/resize objects twice as fast.

Game Control

Needs to keep an array of missile structs.

- You could use one big array, or separate arrays per type.

gameControl_init()

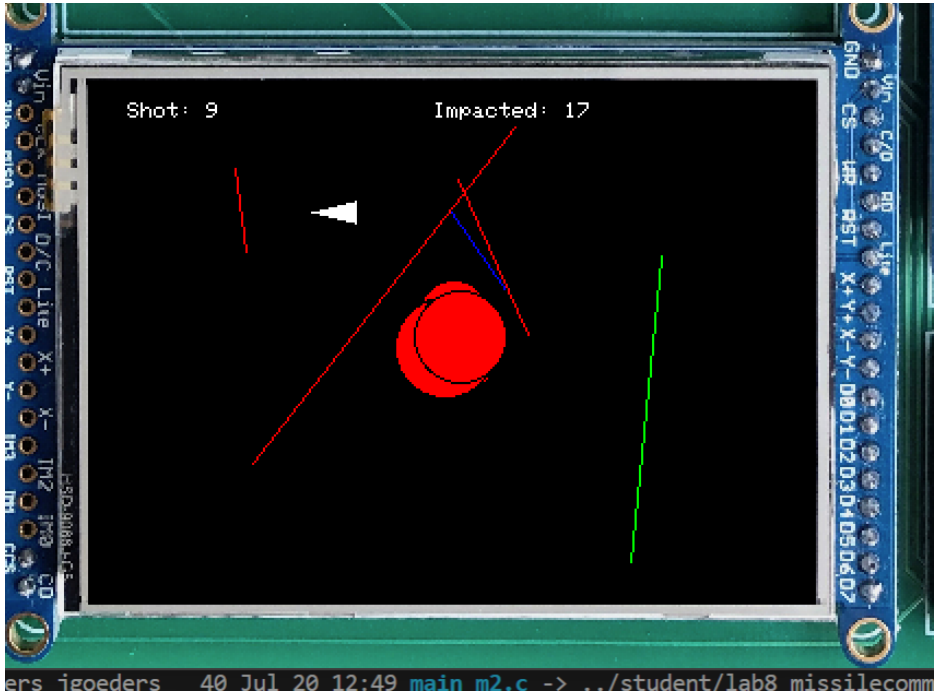
- Initialize all of your missiles

gameControl_tick()

- Tick **HALF** your missiles
- If enemy missile is dead, relaunch it (call init again)
- If touchscreen touched, launch player missile (if one is available)
- Detect collisions

Milestone 3: Plane + Stats

- Create a state machine for your plane
  - Fly right to left
  - Plane can be destroyed by an explosion (no explosion animation)
  - Shoot a missile while flying
  - Wait a while to reappear after leaving or being destroyed



Stats

- Keep track of
  1. Number of missiles shot by player

  2. Number of enemy/plane missiles that impact the ground
     - The **impacted** struct member can be used for this
       - Set to true when impacted
       - Set to false when you read it and update your stat counters

- Draw the stats at the top of the screen

Updated Game Control for M3

gameControl_init()

- Initialize all of your missiles
- **Initialize stats**

gameControl_tick()

- Tick HALF of your missiles
- **Tick plane**
- If enemy missile is dead, relaunch it (call init again)
- If touchscreen touched, launch player missile (if one is available)
- Detect collisions
- **Draw stats**