Course: **EECS 3311 Section A**
Semester: **Fall 2020**
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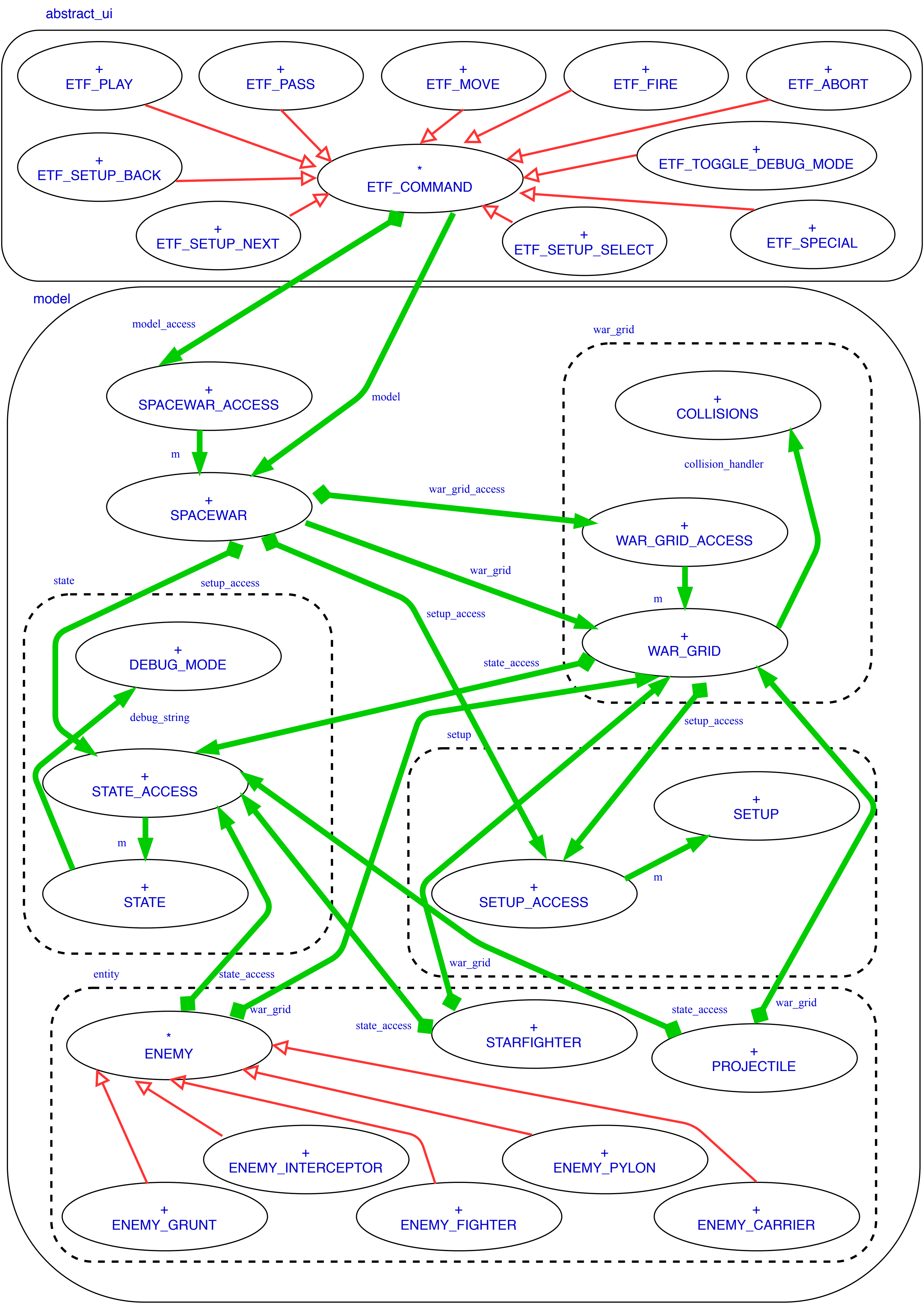
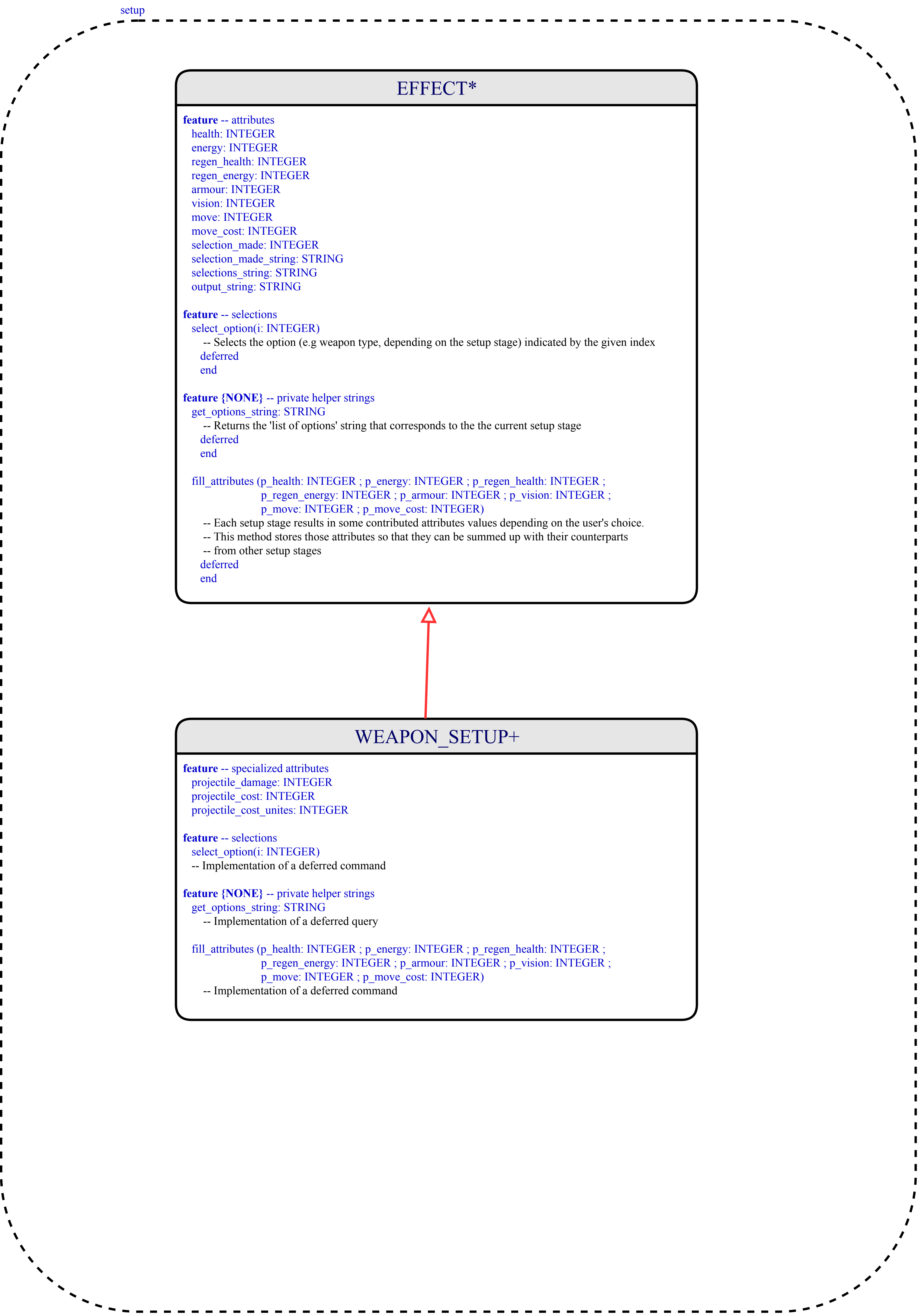

abstract_ui
+ ETF_PLAY
+ ETF_PASS
+ ETF_MOVE
+ ETF_FIRE
+ ETF_ABORT
+ ETF_SETUP_BACK
* ETF_COMMAND
+ ETF_TOGGLE_DEBUG_MODE
+ ETF_SETUP_NEXT
+ ETF_SETUP_SELECT
+ ETF_SPECIAL
model
model_access
model
+ SPACEWAR_ACCESS
m
+ SPACEWAR
war_grid
+ COLLISIONS
collision_handler
war_grid_access
+ WAR_GRID_ACCESS
war_grid
m
+ WAR_GRID
state
setup_access
setup_access
+ DEBUG_MODE
state_access
debug_string
setup
setup_access
+ STATE_ACCESS
+ SETUP
m
m
+ STATE
+ SETUP_ACCESS
war_grid
entity
state_access
war_grid
state_access
state_access
war_grid
* ENEMY
+ STARFIGHTER
+ PROJECTILE
+ ENEMY_INTERCEPTOR
+ ENEMY_PYLON
+ ENEMY_GRUNT
+ ENEMY_FIGHTER
+ ENEMY_CARRIER



```
EFFECT*

feature -- attributes
  health: INTEGER
  energy: INTEGER
  regen_health: INTEGER
  regen_energy: INTEGER
  armour: INTEGER
  vision: INTEGER
  move: INTEGER
  move_cost: INTEGER
  selection_made: INTEGER
  selection_made_string: STRING
  selections_string: STRING
  output_string: STRING

feature -- selections
  select_option(i: INTEGER)
     -- Selects the option (e.g weapon type, depending on the setup stage) indicated by the given index
    deferred
    end

feature {NONE} -- private helper strings
  get_options_string: STRING
     -- Returns the 'list of options' string that corresponds to the the current setup stage
    deferred
    end

  fill_attributes (p_health: INTEGER ; p_energy: INTEGER ; p_regen_health: INTEGER ;
                   p_regen_energy: INTEGER ; p_armour: INTEGER ; p_vision: INTEGER ;
                   p_move: INTEGER ; p_move_cost: INTEGER)
     -- Each setup stage results in some contributed attributes values depending on the user's choice.
     -- This method stores those attributes so that they can be summed up with their counterparts
     -- from other setup stages
    deferred
    end
```

```
WEAPON_SETUP+

feature -- specialized attributes
  projectile_damage: INTEGER
  projectile_cost: INTEGER
  projectile_cost_unites: INTEGER

feature -- selections
  select_option(i: INTEGER)
  -- Implementation of a deferred command

feature {NONE} -- private helper strings
  get_options_string: STRING
     -- Implementation of a deferred query

  fill_attributes (p_health: INTEGER ; p_energy: INTEGER ; p_regen_health: INTEGER ;
                   p_regen_energy: INTEGER ; p_armour: INTEGER ; p_vision: INTEGER ;
                   p_move: INTEGER ; p_move_cost: INTEGER)
     -- Implementation of a deferred command
```

Section: Enemy Action

The core of the design is relying upon the fact that enemy actions are triggered by the starfighter's actions. With that in mind, I have defined a routine for each of the 7 phases in a turn in the WAR_GRID class, and a “perform_turn” routine in the SPACEWAR class which executes all 7 phases in order.

When the starfighter takes an action (i.e – pass, move, fire, special), the action is always carried out in phase 3. The starfighter stores the last action in a local variable in SPACEWAR class.
For example

```
    fire
        local
            setup_access: SETUP_ACCESS
            setup: SETUP
        do
            setup := setup_access.m
            if setup.setup_has_begun = false then
                process_not_in_game_error
            else
                if setup.current_step <= 5 then
                -- during setup
                    process_not_in_game_error

                -- in game
                else
                    last_command := "fire"
                    process_command
                end
            end
        end
```

When the “perform_turn” routine is executed later on, it already knows what was the starfighter’s last action, and so, the routine taking care of phase 5 (enemy action) knows too.

```
    perform_turn
        local
            war_grid_access: WAR_GRID_ACCESS
            war_grid: WAR_GRID
        do
            war_grid := war_grid_access.m
            war_grid.perform_phase_1
            war_grid.perform_phase_2
            war_grid.perform_phase_3 (last_command, last_move_to_tgt_row,
                last_move_to_tgt_col)
            war_grid.perform_phase_4
            war_grid.perform_phase_5 (last_command)
            war_grid.perform_phase_6
            war_grid.perform_phase_7
            if war_grid.starfighter.is_dead then
                state_header.name := "not started"
            end
        end
```

Given that phase 5 knows what was the starfighter’s last action, the enemy can preempt accordingly by checking the relevant actions (based on the type of the enemy).
For example:

```
preempt_action (pass: BOOLEAN ; fire: BOOLEAN ; move: BOOLEAN ; special:
        BOOLEAN): BOOLEAN
        do
                if is_on_grid then
                        if pass then
                                health := health+10
                                max_health := max_health+10
                                report_enemy_gains_total_health (10)
                        elseif special then
                                health := health+20
                                max_health := max_health+20
                                report_enemy_gains_total_health (20)
                        end
                        Result := false
                else
                        Result := true
                end
        end
```

Depending on the enemy type and/or the starfighter’s last move, the enemy may end its turn. If it doesn’t, it will act. First all enemies preempt their actions and the ones that did not finish their turn will be added to a list. Then after all enemies have preempted, the enemies in the list who still need to act will do so.

Satisfaction of design principles:
- Information hiding
In the enemy class, the methods “preempt_action” as well as “act” are not hidden. They considered stable as they are directly deduced by the basic requirements of the game.
On the other hand, the way that the move itself is carried out can be adjusted.
The enemy moving happens in “perform_move” in enemy class. The routine “perform_move” is hidden from clients.
I actually changed the design more than once during development and that resulted in changing the content of “perform_move” but it did not have any effect on clients using the class (i.e – WAR_GRID).
Also, an enemy may spawn a projectile during its act, and that too, “spawn_projectile”, is hidden as it may be changed. For instance, at first I let the projectiles undergo collision inspections before spawning. But later on I saw the need to do it the other way around, so I did not have to change anything in client classes.

- Single Choice Principle
All enemies, and thus enemy actions, are designed using inheritance. There is a main deferred class, ENEMY, which defines all shared code in one place, in addition to deferred routines that will later on be defined by the individual enemy classes that inherit from ENEMY. Thus ensuring that if a change has to be made, it will be made in one place only.
Note: The individual enemy classes extend ENEMY by adding their own specialized attributes and routines to either beautify or simplify the code.

- Cohesion
The attributes in the ENEMY class are shared among all its descendants. Some descendants though, such as ENEMY_GRUNT, have few more attributes to maintain. Those attributes are defined in the class that needs them rather than in the ancestor class, thus satisfying cohesion.
When an enemy moves for instance, the debug string reporting what happened is the same regardless to the type of the enemy. The routine taking care of that was defined and implemented in the ancestor ENEMY class, where it can be used by any enemy object inheriting from ENEMY.

- Programming from the interface
In phase 5, every enemy will preempt, and those that did not finish their turn will still need to act. Those enemy were collected in a LIST, that was created at run time with ARRAYED_LIST cast.
Also, all enemies ever created are collected in a LIST as well, called “enemies” in class WAR_GRID. The runtime type is also ARRAYED_LIST. If for any reason in the future we decide to change the run time type to, say LINKED_LIST, none of the clients of WAR_GRID would be affected as they are using the interface itself, not the implementation.

```
-- Entity initialization
create starfighter.make (row_count)
create {ARRAYED_LIST[PROJECTILE]} projectiles.make (10)
create {ARRAYED_LIST[ENEMY]} enemies.make (10)
```

Section: Scoring of Starfighter
There’s a deferred ancestor class called SCORE_ITEM, that has the descendant classes ORB as well as FOCUS. The idea is that an orb and a focus are both a SCORE_ITEM.
There are only 2 routines for us to be concerned with:
1. “add_score_item”
2. “get_value”

The starfighter maintains a focus (FOCUS) where scores items (i.e ORB or FOCUS) can be added. When an enemy dies, it accesses the starfighter’s focus and executes “add_score_item” on it, adding either an orb or a focus (depending on the enemy type).

Whenever it’s time to print the state strings and content, the very last step is to print the starfighter’s score, by executing “get_value” on the starfighter’s focus.

- add_score_item
Traverse the starfighter’s focus left to right, if the current item is an orb, go on and ignore.
If the current item is a focus, try to add the score item there recursively.
If successful, end. Otherwise, keep traversing rightward in the original focus.
If there is absolutely no place in any of the focuses within the starfighter’s focus, append the score item to the right of the starfighter’s focus.

- get_value
Traverse the starfighter’s focus left to right, add the value of the current element to the overall value by executing “get_value” on the current score element. If the current score element is a focus, the routine “get_value” is executed recursively on the current score element.
If at any point in time we land on a full focus, we multiply its value by the relevant factor depending on the focus type.

Satisfaction of design principles:
- Information hiding
In the FOCUS class, there’s a method called “is_full”. This method is used to query whether a focus is full during the calculation of the value. If I decide to improve the overall design next week and thus change the way I check if a focus is full, that would not affect any client class because the method is hidden.
On the other hand, “add_score_item” as well as “get_value” are public as a design choice, since they are used by clients such as ENEMY descendants. Their content though can be updated seamlessly because the client class does not see anything but those 2 routines.

- Single Choice Principle
The class SCORE_ITEM has the attributes that are common to both ORB and FOCUS classes.
It ensures that if for any reason we decided to change the name or the type of those attributes, we only need to change them in one place – thus satisfying the single choice principle.
Beyond the attributes, there are only 3 deferred methods in SCORE_ITEM and they’re all implemented in the descendant classes.

- Cohesion
As mentioned above, the SCORE_ITEM class has 3 deferred methods.
In particular, let’s consider “add_score_item”. While this method makes sense for the FOCUS descendant, it does not make any sense for the ORB descendant.
This violates cohesion because the ORB class has irrelevant functionality.
As a consequence, the ancestor SCORE_ITEM class also has some irrelevant attributes to any of the two descendants we choose. As seen here

```
feature -- attributes
	type: INTEGER
	value: INTEGER
	multiply_factor: INTEGER
	is_starfighter_focus: BOOLEAN
	t_orb: INTEGER
	t_focus: INTEGER
```

The attribute “multiply_factor” is not needed in the ORB descendant, thus again, violating cohesion.
The reason I designed it that way is for speed of programming, given another equally tough project in EECS3431. But if this was a project conducted in real life (or if EECS3311 was the only course I was taking), then a much better design can be created that would satisfy cohesion by definition.

- Programming from the interface
The starfighter’s focus (and by extension, any FOCUS object), has an attribute of type LIST, with all the focus’s content.
The dynamic type of the focus is ARRAYED_LIST, but all clients of the list in FOCUS use the LIST interface to add or get elements in the focus. Thus, if we change the dynamic type to LINKED_LIST for example, the clients would not be affected.