Behavioral Patterns

JS Patterns and Anti Patterns

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Outline

- Behavior pattern in general
- Command
- Memento
- Chain of responsibility
- Observer
- Iterator
- Strategy
- Template method
- State

Outline

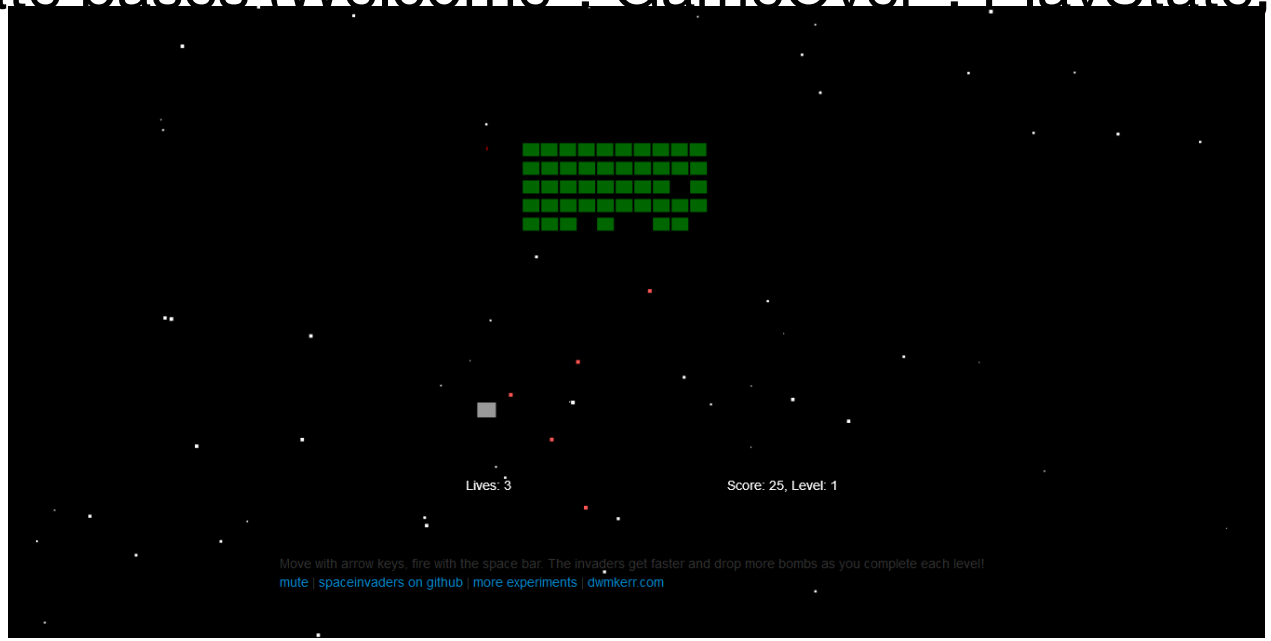
- Behavior pattern in general
- **Command**
- **Memento**
- **Chain of responsibility**
- **Observer**
- Iterator
- Strategy
- Template method
- State

Behavior Pattern in general

- Mainly concerned with the communication between objects.
- Chain of responsibility
- Command
- Interpreter
- Iterator
- Mediator
- Memento
- Null Object
- Observer
- State
- Strategy
- Template method
- Visitor

Spaceinvader

- Retro Game: shooting Spaceinvader
- Level bases
- State bases (Welcome-, GameOver-, PlayState, ect.)



Command

- Encapsulate a request as an Object
- Request without knowing anything about the operation being requested. - “Black box execute()”
- Uses: GUI buttons, Networking, Multi-level undo, Progress bar

Command - Participants

- **Client**: decides which command at which point
- **Receiver**: knows how to carry out the operation
- **Command**: execute()
- **Invoker**: knows how to execute

http://www.dofactory.com/images/diagrams/javascript/javascript-command.jpg

Command - Spaceinvader 1/4

Before:

```
if(game.pressedKeys[37]) {
	this.ship.x -= this.shipSpeed * dt;
}
if(game.pressedKeys[39]) {
	this.ship.x += this.shipSpeed * dt;
}
if(game.pressedKeys[32]) {
	this.fireRocket();
}
[…]
bomb.y += dt * bomb.velocity;
[…]
rocket.y -= dt * rocket.velocity;
```

Command - Spaceinvader 2/4

after:

```
var goLeft = {
        execute : function(obj, speed) {
                obj.x -= speed * dt;
        }
}
var goRight = {
        execute : function(obj, speed) {
                obj.x += speed * dt;
        }
}
var shoot = {
        execute : function(obj) {
                obj.fireRocket();
        }
}
```

Command - Spaceinvader 3/4

after:

```
var goUp = {
        execute : function(obj, speed) {
                obj.y -= speed * dt;
        }
}

var goDown = {
        execute : function(obj, speed) {
                obj.y += speed * dt;
        }
}
```

Command - Spaceinvader 4/4

after:

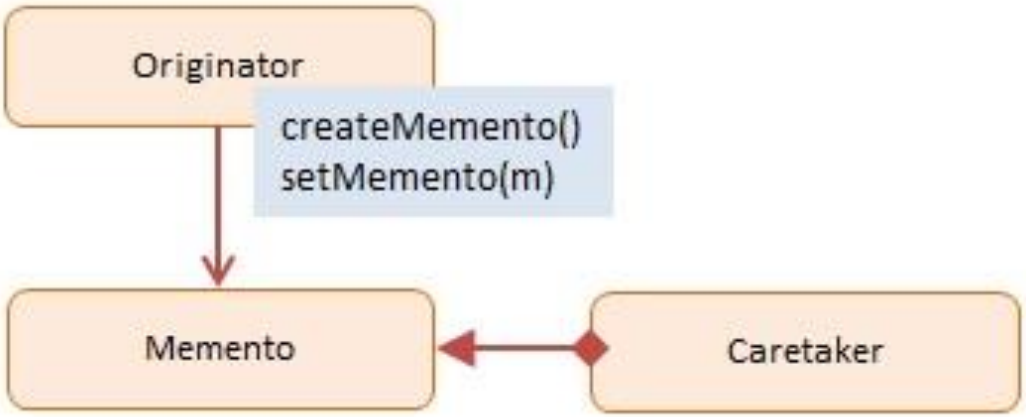
```
if(game.pressedKeys[37]) {
        goLeft.execute(this.ship, this.shipSpeed);
}
if(game.pressedKeys[39]) {
        goRight.execute(this.ship, this.shipSpeed);
}
if(game.pressedKeys[32]) {
        shoot.execute(this);
}
[…]
goDown.execute(bomb, bomb.velocity);
[…]
goUp.execute(rocket, rocket.velocity);
```

Memento

- Capturing and externalizing an object's internal state to be restored later.
- Database for "save point"
- Use: used to avoid disclosure of implementation details

Memento - Participants

- **Originator**: Interface to create and restore mementos
- **Memento**: Ordinator object
- **Caretaker**: stores mementos



http://www.dofactory.com/images/diagrams/javascript/javascript-memento.jpg

Memento - Spaceinvader 1/3

before:

```
WelcomeState.prototype.keyDown = function(game, keyCode) {
[…]
        game.moveToState(new LevelIntroState(game.level));
};
[…]


GameOverState.prototype.keyDown = function(game, keyCode)
[…]
        game.moveToState(new LevelIntroState(1));
}
```

Memento - Spaceinvader 2/3

after:

```
function Memento(state){
	this.state = state;
	this.getSavedState = function(){
		return this.state;
	};
};
function Caretaker(){
	var saveState = [];
	this.addMemento = function(memento){
		saveState.push(memento);
	};
	this.getMemento = function(index){
		return saveState[index];
	};
};
```

Memento - Spaceinvader 3/3

after:

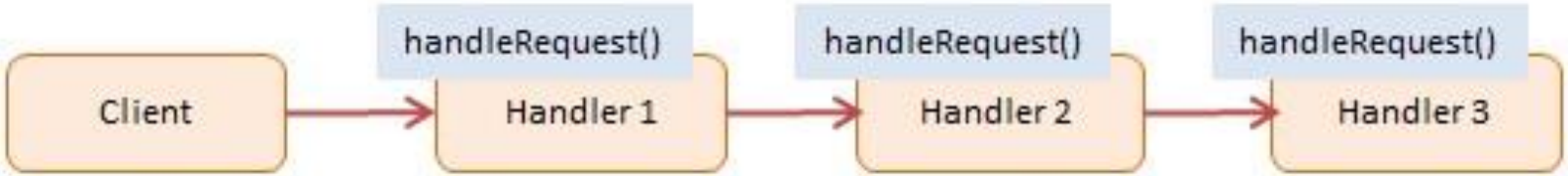
```
caretaker = new Caretaker();
[…]

WelcomeState.prototype.keyDown = function(game, keyCode) {
[…]
caretaker.addMemento(new Memento(new LevelIntroState(game.level)));
        game.moveToState((caretaker.getMemento(0)).getSavedState())

    }
};
[…]

GameOverState.prototype.keyDown = function(game, keyCode) {
[…]
game.moveToState((caretaker.getMemento(0)).getSavedState());
    }
};
```

Chain of responsibility

- Avoid coupling the sender of a request to its receiver.
- More than one object have the chance to handle the request.
- linear search for a handler

Chain of responsibility - Participants

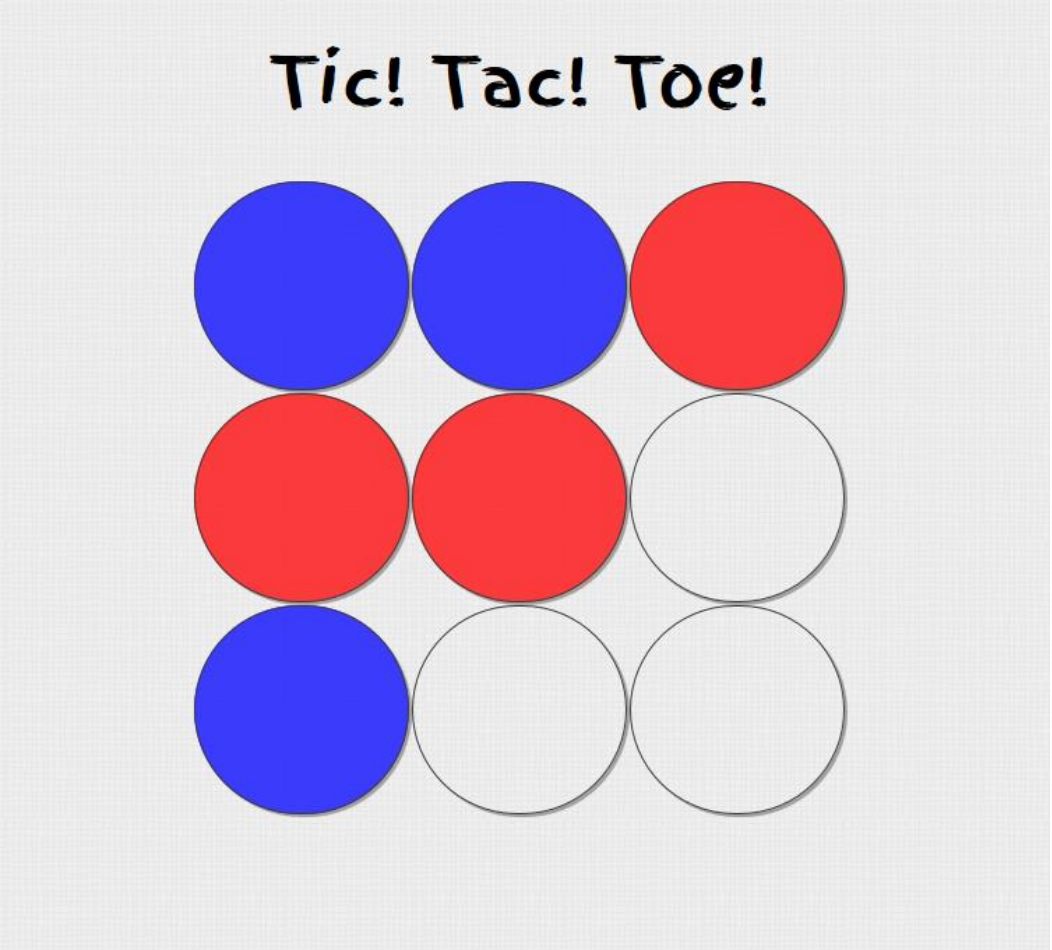
- **Client**: Initiator of the request
- **Handler**: has an interface for handling the request



http://www.dofactory.com/images/diagrams/javascript/javascript-chain-of-responsibility.jpg

Tic Tac Toe

- retro Game
- 2 player
- checks winner or tie after each turn
- restarts



Chain of responsibility - Tic tac toe 1/6

before:

```
function checkWinner() {
	if (checkRows() === true || checkCols() === true ||
checkDiag() === true) {
		winningPlayer = turn.currentPlayerColor();
		// Alert winner
		endGame("Player " + winningPlayer + ", you
win!");
	}
	else if (checkTie() === true) {
		endGame("It's a tie...");
	}
	else {
		turn.changeTurn();
	}
}
```

Chain of responsibility - Tic tac toe 2/6

before:

```
function checkRows() {
	for (i = 0; i < board.length; i++) {
		var same = true;
		for (j = 0; j < board[i].length; j++) {
			if (board[i][j] === 0 || board[i][j]
!== board[i][0]) {
				same = false;
			}
		}
		if (same) {
			return same;
		}
	}
}
```

Chain of responsibility - Tic tac toe 3/6

before:

```
function checkTie() {
	var flattenedBoard =
Array.prototype.concat.apply([], board);
	for(i = 0; i < flattenedBoard.length; i++){
		if(flattenedBoard[i] === 0){
			console.log(i);
			return false;
		}
	}
	return true;
}
```

Chain of responsibility - Tic tac toe 4/6

after:

```
function checkWinner() {
        checkRows();

}
```

Chain of responsibility - Tic tac toe 5/6

after:

```
function checkRows() {
        for (i = 0; i < board.length; i++) {
                var same = true;
                for (j = 0; j < board[i].length; j++) {
                        if (board[i][j] === 0 || board[i][j] !==
board[i][0]) {
                                same = false;
                        }
                }
                if (same) {
                        winningPlayer = turn.currentPlayerColor();
                        // Alert winner
                        endGame("Player " + winningPlayer + ", you
win!");
                }
        }
        checkCols();};
```

Chain of responsibility - Tic tac toe 6/6

after:

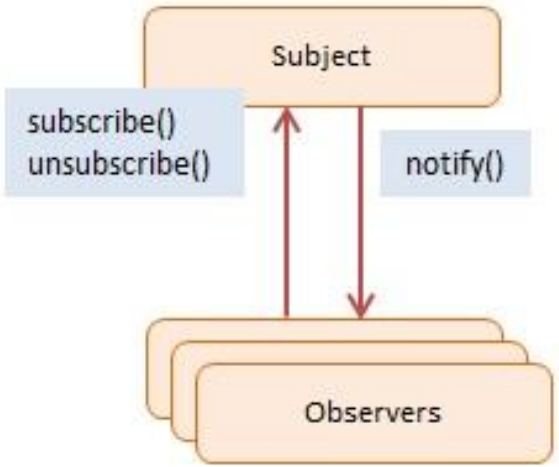
```
function checkTie() {
        var flattenedBoard = Array.prototype.concat.apply([],
board);
        for(i = 0; i < flattenedBoard.length; i++){
                if(flattenedBoard[i] === 0){
                        console.log(i);
                        turn.changeTurn();
                        return;
                }
        }
        endGame("It's a tie...");
}
```

Observer

- Define a one-to-many dependency between objects
- When one object (Observable) changes its state, all dependent objects (Observers) are notified (usually with a message)
- Notified objects handle their own update

Observer - Participants

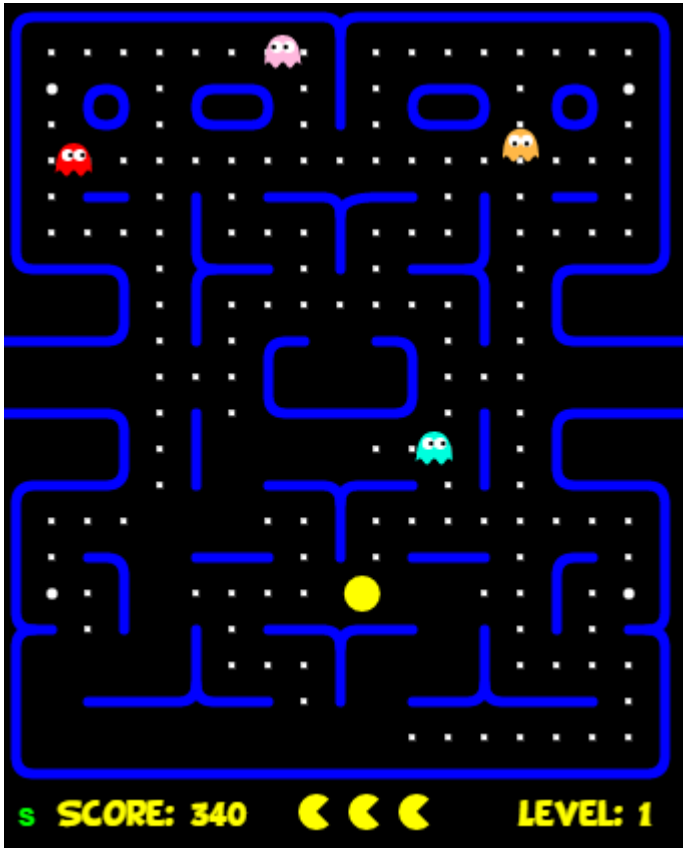
- **Subject / Observable**: Maintains a list of observers, lets them subscribe/unsubscribe, and notifies them about changes
- **Observers**: Has a function that can be invoked when notified



http://http://www.dofactory.com/images/diagrams/javascript/javascript-observer.jpg

Pac Man

- retro game (classic pacman)
- 3 lives
- avoid getting eaten by ghosts
- can eat and “jail” the ghosts for a short time after eating “beans”
- eat all the blocks to a level



Observer – Pac Man 1/5

before:

```
function startLevel() {
        user.resetPosition();
        for (var i = 0; i < ghosts.length; i += 1) {
                ghosts[i].reset();
        }
        audio.play("start");
        timerStart = tick;
        setState(COUNTDOWN);
}
```

Observer – Pac Man 2/5

before:

```
function eatenPill() {
        audio.play("eatpill");
        timerStart = tick;
        eatenCount = 0;
        for (i = 0; i < ghosts.length; i += 1) {
                ghosts[i].makeEatable(ctx);
        }
};
```

Observer – Pac Man 3/5

after:

```
function startLevel() {
        user.resetPosition();
        notifyObservers("levelstarted");
        timerStart = tick;
        setState(COUNTDOWN);
}

[…]

function eatenPill() {
        timerStart = tick;
        eatenCount = 0;
        notifyObservers("pilleaten");
};
```

Observer – Pac Man 4/5

after:

```
//REFACTOR: adding observable functionalities
function subscribe(o) {
	observers.push(o);
};

function unsubscribe(o) {
	observers = observers.filter(
		function(item) {
			if (item !== o) { return item; } }
	); };

function notifyObservers(message) {
	for (var i = observers.length - 1; i >= 0; i--) {
		observers[i].notify(message);
	}; };
```

Observer – Pac Man 5/5

after:

```
//REFACTOR: adding observer functionalities for Ghost
function notify(message) {
        switch(message) {
                case "levelstarted":
                        reset();
                        break;
                case "pilleaten":
                        makeEatable();
                        break;
                default:
                        break;
        }
};
```

(Analog for Audio)

Iterator

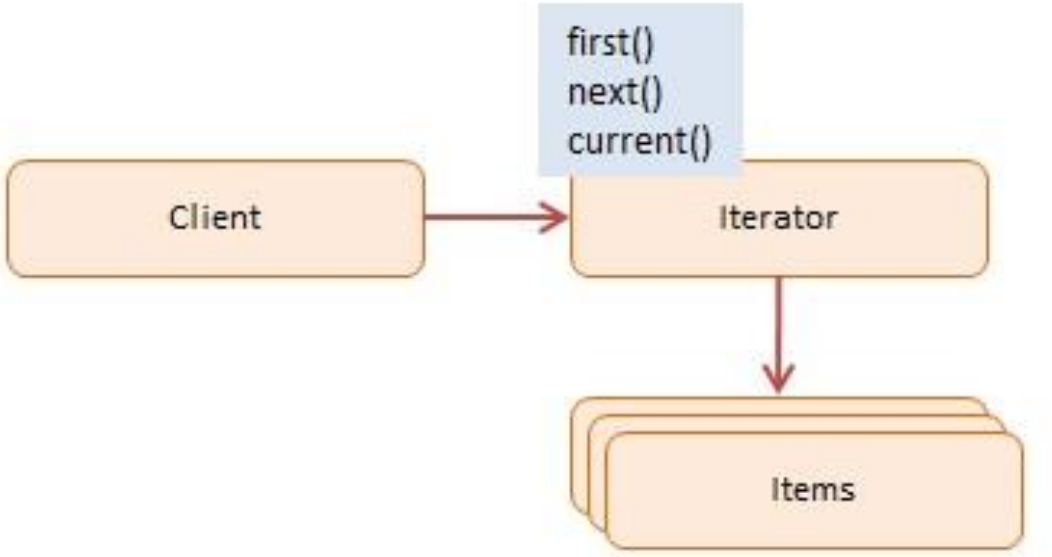
- access elements without knowing the underlying structure of the object
- effectively loop over a object collection
- object store as list, trees or more complex structures
- many language have build in iterator, but not JavaScript
- Iterator is the “secretary”

Iterator - Participants

Client: Uses the iterator

Iterator: Interface with methods like first(), next(), hasNext()

Items: individual objects



http://www.dofactory.com/images/diagrams/javascript/javascript-iterator.jpg

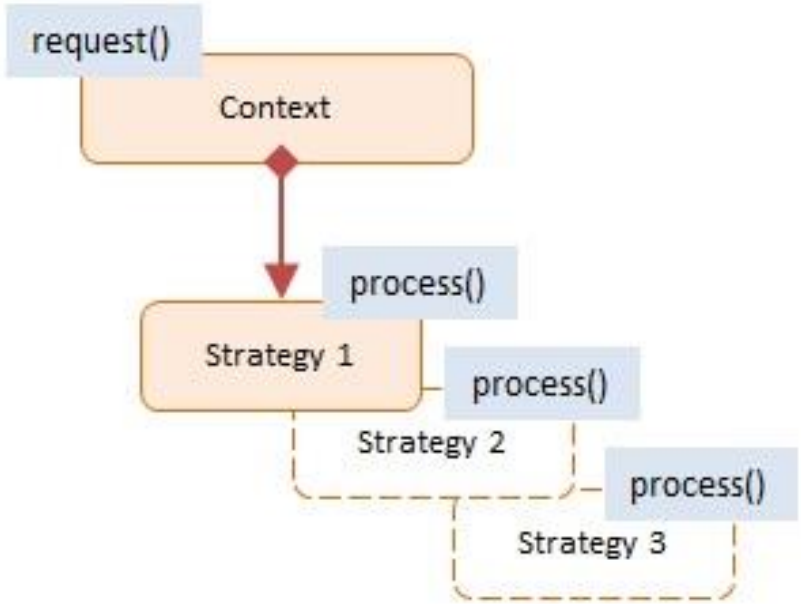
Strategie

- Interchangeable set of algorithms
- swapped out at runtime
- minimizing coupling
- option to hide implementation

Strategie - Participants

Context: reference to the current Strategy, the option to change it and to calculate the “cost” of each strategy

Strategy: implementation of different option for a task



http://www.dofactory.com/images/diagrams/javascript/javascript-strategy.jpg

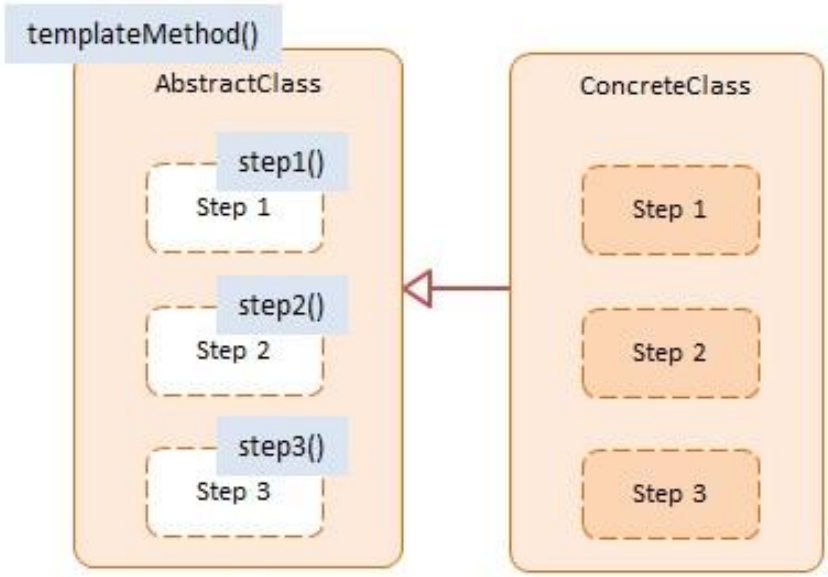
Template method

- Outline of a series of steps for an algorithm
- Subclasses can redefine certain steps of an algorithm without changing the algorithms structure
- Offers extensibility to the client developer

Template method - Participants

AbstractClass: template method defining the primitive steps for an algorithms

ConcreteClass: implements the primitive steps as defined



http://www.dofactory.com/images/diagrams/javascript/javascript-template-method.jpg

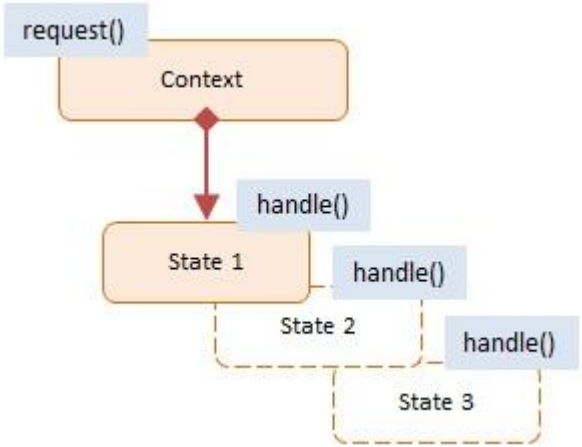
State

- A object can alter its behaviour when its internal state changes
- Object appears to have changed its class
- E.g. state machines

State - Participants

Context: Maintains a reference to a object, defines its current state, and allows it to change its state

State: State values are associated with the according behaviour of the state



http://www.dofactory.com/images/diagrams/javascript/javascript-state.jpg

Sources

http://www.dofactory.com/javascript/design-patterns

https://sourcemaking.com/design_patterns

http://www.blackwasp.co.uk/DesignPatternsArticles.aspx

https://en.wikipedia.org/wiki/Command_pattern

https://de.wikipedia.org/wiki/Memento_%28Entwurfsmuster%29

https://en.wikipedia.org/wiki/Chain-of-responsibility_pattern

Projects

Spaceinvader: https://github.com/dwmkerr/spaceinvaders

Tic Tac Toe: https://github.com/negomi/tic-tac-toe

Pacman: https://github.com/daleharvey/pacman