COMS 4115
Final Project
Card Game Language (CGL)

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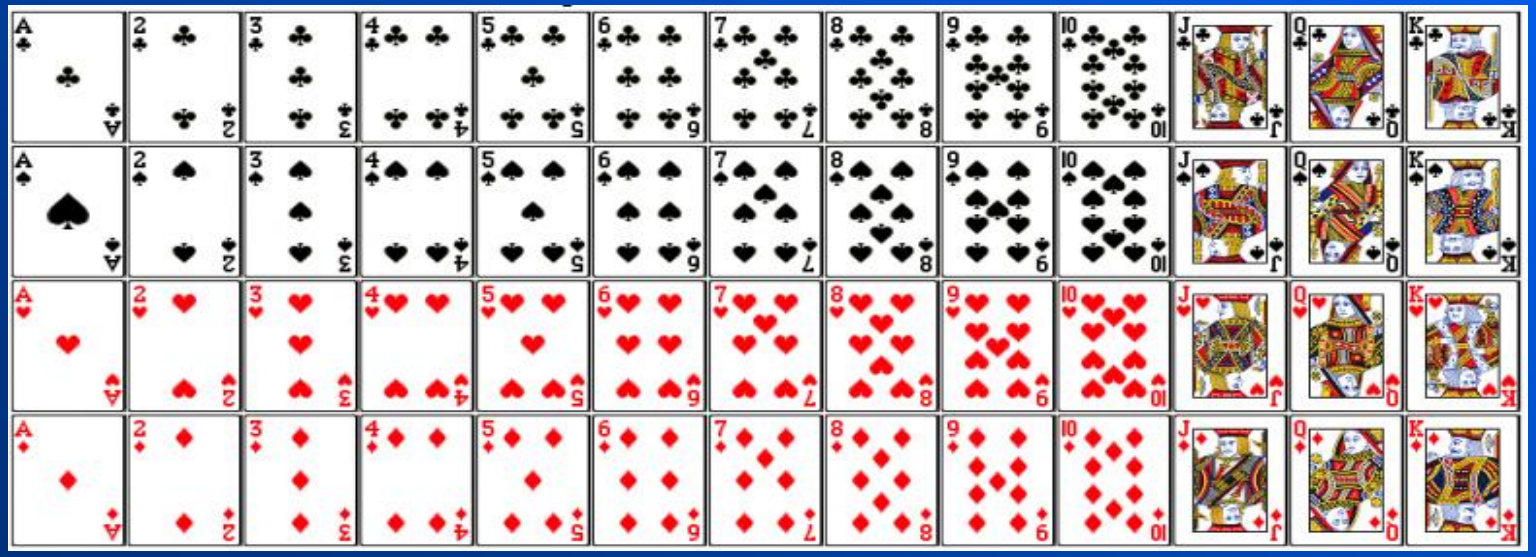
Overview of CGL

- CGL is a programming language used for creating and compiling turn-based card games.

- The compiler allows the creation of games that employ cards from the standard 52-card deck:



Motivation

- Why Card Games?
  - Widespread popularity
  - Rich history
- Minimal data requirements, just player info and 52 symbols, but hard to define game rules using current languages.
  - Turn order
  - Shuffling and dealing
  - Player actions
  - Complex Win Conditions
- CGL was designed to simplify encoding these requirements.

Tutorial Introduction to CGL

- A CGL program is defined using four types of blocks:

```
PLAYER{ }
SETUP{ }
TURN 1 { }
   …
TURN n { }
 WIN{ }
```

SETUP { } Block

- The only mandatory block.
- Runs immediately after an optional PLAYER { } block, and serves as the entry point into the program.
- Global declarations of variables and functions.
  - Function declarations ONLY in and at beginning of SETUP { }.
- Never runs again after initial termination.

SETUP { } Block

CGL Source Code:

```
/* This setup block declares two players, sets out the player order,
creates a standard deck, shuffles it, and finally calls the turn function
on the first player. */

SETUP
{
string name1 = scan();
string name2 = scan();
player p1 = <name1, 1>;
player p2 = <name2, 1>;
p1.next = p2;
p2.next = p1;
list deck = STANDARD;
deck = shuffle(deck);
turn(p1);
}
```

PLAYER { } Block

- Defines data structure for all players
  (defaults of name:String, turnID:Int)
- Optional, but necessary for most non-trivial games
- Player data accessed through p.varName where p is a player reference.

CGL Source Code:

```
/* This gives each player in the game a score, a turn count, and a
next player */

PLAYER
{
int score = 0;
int turnCount = 0;
player next = NEMO;
}
```

TURN n { }

- Describes game rules and player strategy (both human and AI)

- Examples:
  - query human player for move
  - conservative AI agent's logic
  - aggressive AI agent's logic

- Has access to the current player through the "your" keyword

turn(player p) : your = p

TURN n { }

CGL Source Code:

```
/* If the top card of the deck is a red card, give the
player a point. Then, put the card on the bottom of the
deck. If the player has moved five times, move to the win
block. */

TURN 1
{
if (your.turnCount >= 5)
win();

card c = <- deck;
print(your.name ^ " drew " ^ intToString(value(c)) ^
suit(c) ^ "\n");
if (c == $*D || c == $*H)
your.score = your.score + 1;
print(your.name ^ "'s score is " ^ intToString(your.score)
^ "\n");
deck <+ c;
your.turnCount = your.turnCount + 1;
turn(your.next);
}
```

WIN { }

- The WIN { } block is used to check win conditions and terminate the program.
- This block runs whenever the win() function is called.
- It has access to each player reference, global variables, and functions.
- Unlike TURN n { }, there is no current player reference.

WIN { }

CGL Source Code:

```
/* Tests to see which player drew more red
cards, and declares that player the winner. */

WIN
{
if (p1.score > p2.score)
print(p1.name ^ " wins\n");
else if (p1.score < p2.score)
print(p2.name ^ " wins\n");
else
print("draw\n");
}
```

Example 1: High-Low

CGL Program:

```
the first card has value 10
will the next card be (h)igher or (l)ower?
l

new card's value is 2
correct prediction
will the next card be (h)igher or (l)ower?
h

new card's value is 8
correct prediction
will the next card be (h)igher or (l)ower?
h

new card's value is 5
incorrect prediction; game over
total score = 2
```

Example 2: Black-Jack

Setup Stage:

```
Please enter Player name
Professor Edwards
Please enter 1 if human, or 2 if AI
1
Please enter Player name
Mark
Please enter 1 if human, or 2 if AI
1
Please enter Player name
Kevin
Please enter 1 if human, or 2 if AI
1
Please enter Player name
Dealer
Please enter 1 if human, or 2 if AI
2
```

Example 2: Black-Jack

Gameplay Stage:

```
Kevin’s turn; press enter to continue
you have KD 4H
type "h" for hit; anything else for stay
h
you got a 2S
Kevin's turn; press enter to continue
you have KD 4H 2S
type "h" for hit; anything else for stay
h
you got a 3H
you have KD 4H 2S 3H
Type “h” for hit; anything else for stay
s

Professor Edwards scored 21
Mark scored 16
Kevin scored 19
Dealer scored 0
Professor Edwards wins
```

How CGL was Implemented

- OCAML –

  1) Scanner.mll (ocamllex), parser.mly (ocamlyacc), ast.mli

  2) generator.ml, corelibrary.ml, javalibrary.ml, cgl.ml

  3) sast.mli, semantic_analyzer.ml

- JAVA –

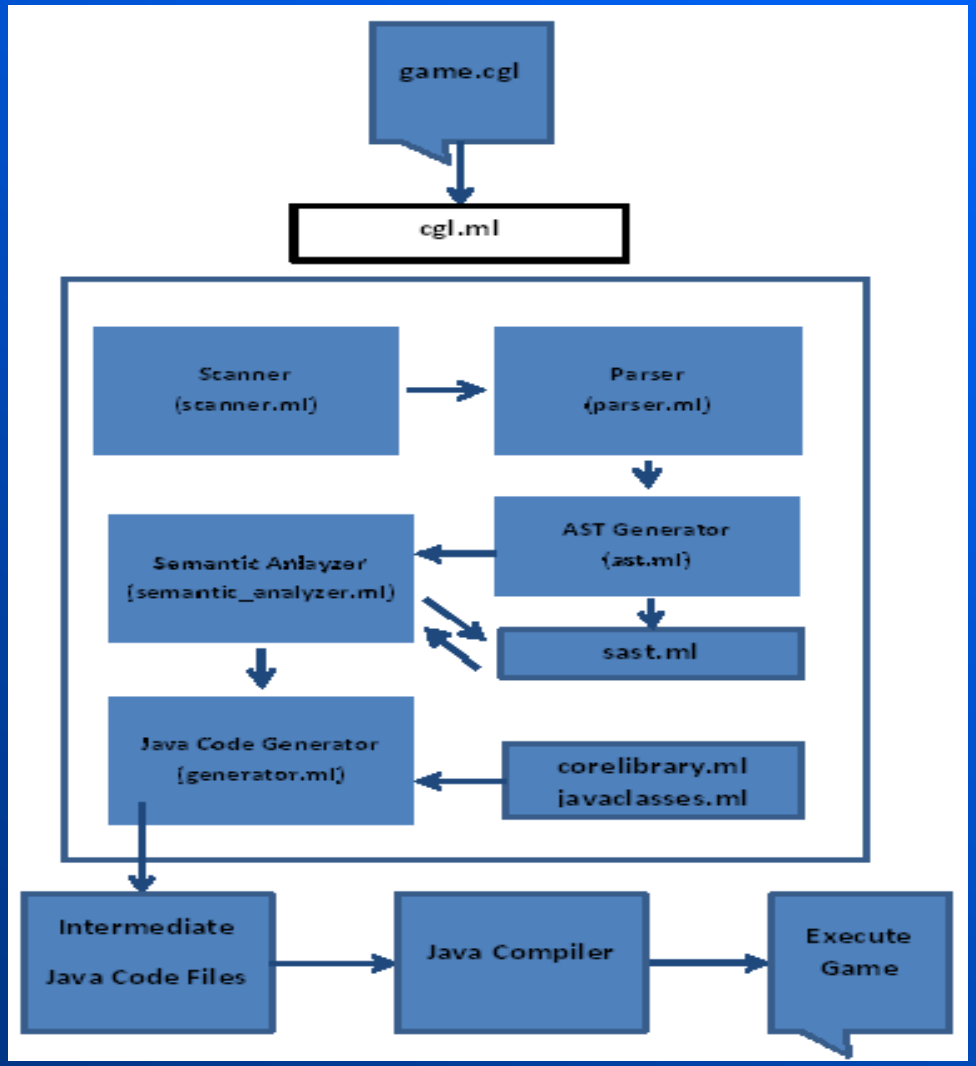
  Main.java, CGLList.java, Card.java, Player.java.

- CGL–

  Unix commands to compile and run:

```
$ .cgl/ -j source.cgl
$ javac *.java
$ java Main
```

Flow of Control / Dependencies



Roles and Responsibilities

- Kevin Henrick (Team Leader) – Semantic Analyzer / SAST, test cases, and Makefile.
- Ryan Jones – Semantic Analyzer / SAST, test cases, CGL Executable and Makefile.
- Mark Micchelli – Scanner, Parser, Abstract Syntax Tree, Generator, CGL Executable, and Makefile.
- Hebo Yang – Test cases, and Bash Script.

CGL Games Created

- Finding the First Ace – Kevin Henrick and Hebo Yang
- RedCard – Mark Micchelli
- HighLow – Mark Micchelli
- Blackjack – Mark Micchelli

Summary of the Project

- We implemented almost all of the LRM, our original conception of the language.
- Future Work: external libraries, more complete semantic analysis, more options in the executable, and bug fixes.

Lessons Learned

- Don’t be afraid to change design choices at the last minute.
- Try to keep all of the parts moving at once.
- Prioritizing starting early was really beneficial!