TETRISJET

TETRIS GAME PROJECT PROPOSAL

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This proposal is made as a partial fullfilment of the requirements for the Midsem assignment submission for COMPILER CONSTRUCTION CS F363, under Prof. Ramprasad S. Joshi .

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TOP LEVEL DESIGN

OVERALL PROGRAM STRUCTURE

We are planning a C/C++ inspired language structure. The programmer will be provided with a procedural and weakly typed language. It will support multiple files via the **`import`** command. This will be done in the preprocessing stage. The language will follow a CSS inspired block overriding idea where the latest definition is considered. The programmer will be editing and adding variations in two ways:

- Config File:
  - Grid Dimensions (Global).
  - Block Shape and Color (Global).
  - Layout (explained in the following sections).
  - Level attributes that can override Global Defaults.

A sample config file:

```
{
      "DefaultGridHeight":10,
      "DefaultGridWidth":6,
      "highScore":0,
      "NumberOfBlocks":5,

"blockColors":["0xFFFFFF","0xFF0000","0x00FF00","0x0000FF","0xFFFF00"],
      "blockShapes":[[[0,0,0,0],[0,0,0,0],[0,0,0,0],[1,1,1,1]],
                           [[0,0,0,0],[0,0,0,0],[0,0,0,1],[0,1,1,1]],
                           [[0,0,0,0],[0,0,0,1],[0,0,0,1],[0,0,1,1]],
                           [[0,0,0,1],[0,0,0,1],[0,0,0,1],[0,0,0,1]],
                           [[0,0,0,0],[0,0,0,0],[0,0,1,1],[0,0,1,1]]],
      "Layout":{
            "R1":"Score",
            "R2":"NextBlock",
            "R3":"CurrentLevel",
            "R4":"HoldBlock"
      },
      "NumberOfLevels":5,
      "Levels":[
            { "velocity":10, "GridHeight":10, "GridWidth":6 },
            { "velocity":12, "GridHeight":9, "GridWidth":6 },
            { "velocity":14, "GridHeight":9, "GridWidth":6 },
            { "velocity":16, "GridHeight":9, "GridWidth":6 },
            { "velocity":18, "GridHeight":9, "GridWidth":6 }]
}
```

- Code Files
  - The programmer will be able to edit event triggered functions to modify behavior.
  - The functions will not be returning values and will each correspond to a specific point in the game execution loop. This was inspired by from the C# interface provided by the Unity3D game engine.
  - The scope of each function will be be pre-decided.

```
import "path_to_file"
onCollisionEnter(Block block){
      block.colour = 'g';
}
onCollisionEnter(Block block){
      block.colour = 'b';
}
onLevelOver(){
      log("Finish");
}
```

KEYWORDS

- Data Types: `block, grid, bool, int, char, float`
- Control Constructs: `if, else`
- Loop: `while, break, continue`
- Modularity: `import`
- Macros: `def, end`
- Events: `onCollisionEnter, onCollisionExit, onBlockSpawn`
- Movement: `goLeft, goRight, goUp, goDown, rotCW, rotACW`

Note: The keyword list here is inexhaustive.

OFFERED PRIMITIVES

The following are the various regions whose positions can be modified by the programmer

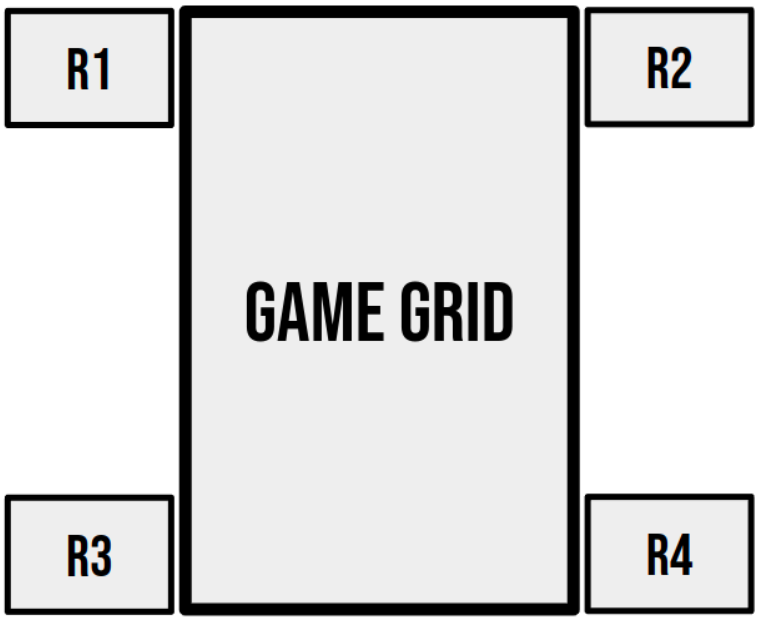


Fig: A sample layout for the GUI

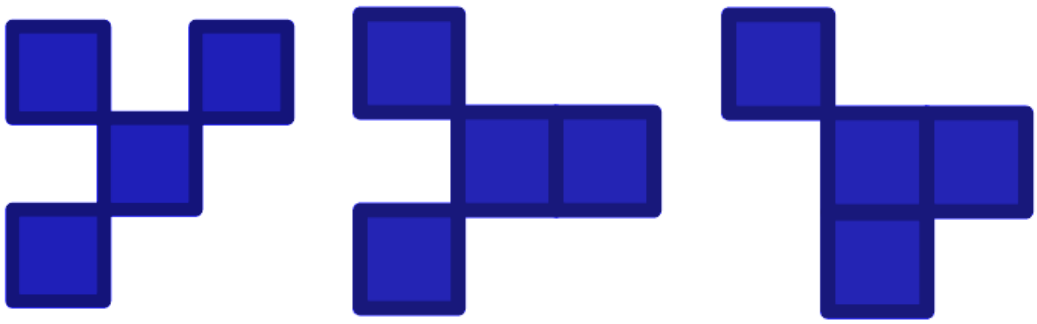
Possibilities for R1 to R4:

- Current and High-Score
- Level Information
- Next Piece
- Hold Piece

The programmer would be able to modify the layout of the game screen using various attributes such as position of the different regions (game grid, R1, R2, R3, R4), the structure and color of the blocks and level attributes such as grid size and velocity of the falling blocks. Apart from this the programmer can also write the logic for what happens based on certain pre-defined in-game events for eg., onCollisionEnter, onLevelOver. The following are a few examples (inexhaustive) of custom game features that the programmer can implement:

- If the game designer wants to have some blocks initially positioned on the game grid at the beginning of a level, they can make use of the onLevelInit event and define the positions and shapes of the blocks to be placed thus giving programmers a freedom of level design in terms of structure of the initial game grid.
- If the game designer can set different behaviors for different collision types (with walls, with pre-initialized blocks, with blocks on the playing field, etc) then they can do so using the onCollision event and modifying the behavior of the colliding entities.
- If the game designer wishes to have a different behavior to update the score when a row clears, they can do so using the onRowClear event.

The structure of the blocks can be defined by changing the block attributes exposed to the programmer to set the position of 4 blocks anywhere on a 4x4 grid and specify their color and if the block should have any special functionality(eg. power ups , etc). Some sample custom sized pieces are shown below:



PROGRAM FEATURES

We plan on allowing support for the **`while`** loops, **`if-else`** conditionals, **`break-continue`** , **`for`** loop control and macros as a preprocessor directive. We justify these choices with the following:

- The main game loop will be handled without the programmer's intervention and hence we do not believe they will require powerful loop structure. For any form of repeated calculations, the provided **`while`** loop will suffice.
- The use of **functional macros** was decided upon as it would reduce scoping issues and would make the parsing and translation more streamlined.

PIPELINE SCHEMA

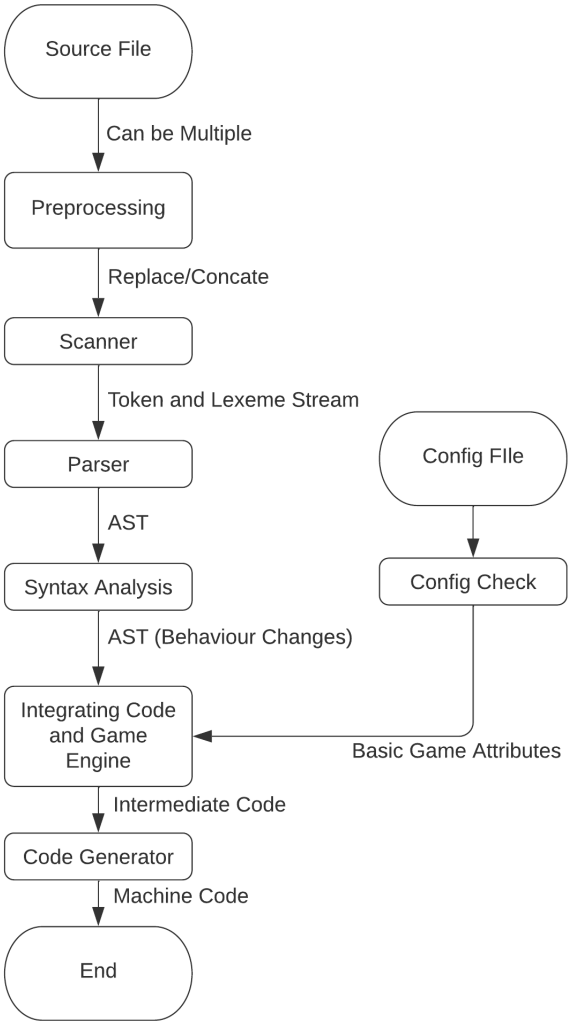


Fig: General Pipeline from Game Programme to Machine Language.

PREPROCESSING

At this stage the **import** and **macro** statements are replaced/injected to generate the complete input file for the scanner. Our plan is to concatenate all import files then following the CSS idea of keeping the latest definitions in a top-down priority.

SCANNER DESIGN

We are planning to use flex as our scanner. The regex based tokenization is sufficient for the language we are designing. Our group's prior experience with flex also influenced this decision. Our target intermediate code and our tentative parser choice of bison also integrate well with flex.

TRANSITION DIAGRAMS

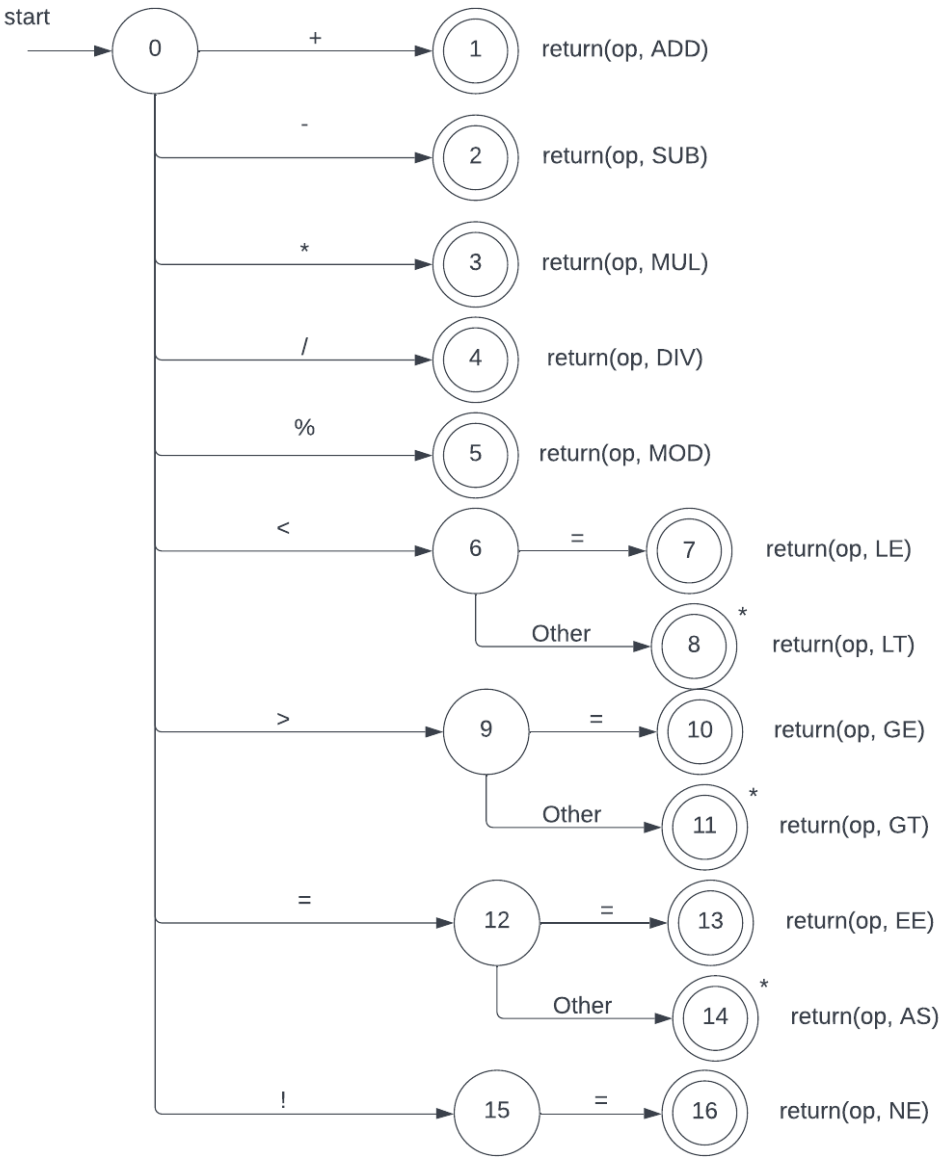


Fig: Transition Diagram for Operators

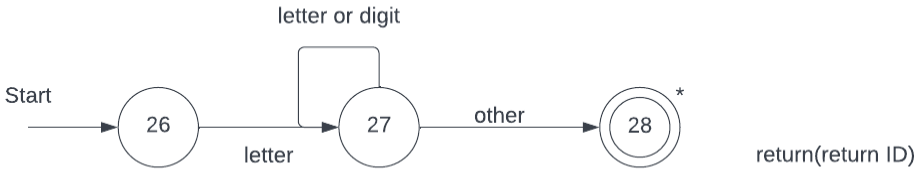


Fig: Transition Diagram for Identifiers

To handle keywords, we have planned to install them in the symbols initially. The symbol table indicates that strings are not ordinary and it tells which token they represent. The function *getToken* examines the symbol table entry for a lexeme found and returns whatever token name the symbol table says the lexeme represents either id or keyword as indicated in the symbol table.

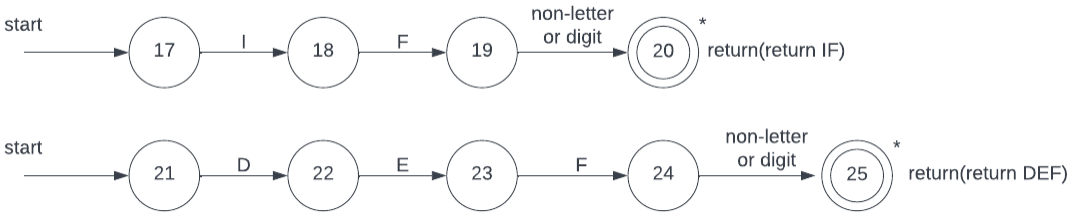


Fig: Transition Diagram for Keywords (if, def).

The handling of keywords (reserved word tokens) must be prioritized before that of identifiers.

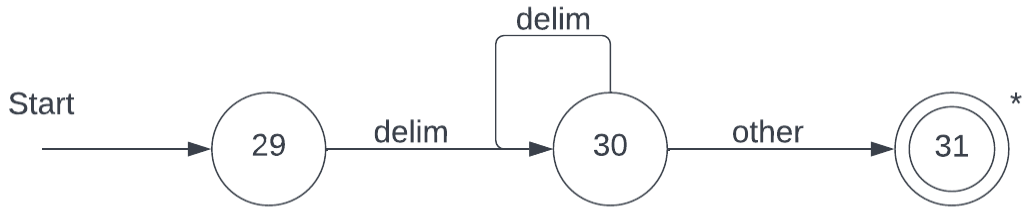


Fig: Transition Diagram for Whitespace.

*: In State 31, we discovered a string of whitespace followed by a non-whitespace character. We return the parser but retract the input to start at the non whitespace. After whitespace, we must resume the lexical analysis procedure.

SCANNER VS PARSER

Our Design relies on a large number of independent tokens for all events and movement commands. This, in turn, means that our pipeline will be scanner heavy. We made this decision as it gives us the most streamlined procedure after the parser and helps us immensely in the modular intermediate code generation we are planning. Our parser will work mainly on assignment and arithmetic statements while exploiting the high token count to parse the function blocks and standard function statements.

TOKENS WITHOUT METADATA

- All **Event Tokens** will correspond to only 1 lexeme, and thus no extra information needs to be passed to the parser.
- The same is true for **Movement Tokens** and primitive datatype tokens such as `int`, `bool`, `block`, `grid`.

TOKENS WITH METADATA

- `Integer`, `float` and `string/char` literals will pass on both the token type and the particular value to the parser.
- **Identifiers** also pass along the lexeme value along with the token type as metadata.

LEXEME OVERLAP

- There is no overlap between **literals** and **identifiers.**
- All our **Event** and **Movement** lexemes have overlaps with possible **identifiers.** We aim to avoid this conflict by giving priority to keyword lexemes in our scanner, thus excluding them from our possible list of identifiers.
- Operators with overlap such as **<** and **<=**, we are giving higher priority to the compound operator to avoid conflicts.

WORK DIVISION

Ramanathan Rajaraman

- Game Physics
  - Collision
  - Rotations
- Event Systems

Vishal Sharma

- Layout Design
- Score Handling
- Event Systems

Tanmay Devale

- Scanner Design
- Layout Design
- Event Systems

Param Biyani

- Special Collison Effects
- GUI and Assets

Sarthak Chaudhary

- Game Physics
  - Grid Analysis
- Event Systems

Vishal Vivek Bharambe

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ACKNOWLEDGEMENTS

The proposal made above is to the best of our knowledge, consistent with the structure we plan to pursue for this project.

We would like to thank our TA Amit Chauhan and Rohit Garg for their guidance and Prof. Ramprasad S. Joshi and Kunal Kishore Korgaonkar.