# CFG

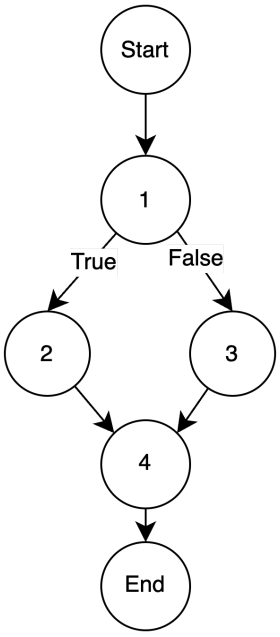
**Team Members:** Jayanth Reddy Gaddam (1002123569)
Jorge Catano (1002149092)

- Control Flow Graphs with source code snippets and block tables for the methods in Printtokens.java file.
- The block table has block numbers with corresponding lines , with entry and exit lines of the blocks. The function calls present in that block are listed in table and marked in red dotted line in CFGs.
- Lines with two statements are splitted into parts a and b.

1. **BufferedReader open_character_stream(String fname):**

```
22    BufferedReader open_character_stream(String fname) {
23        BufferedReader br = null;
24        if (fname == null) {
25            br = new BufferedReader(new InputStreamReader(System.in));
26        } else {
27            try {
28                FileReader fr = new FileReader(fname);
29                br = new BufferedReader(fr);
30            } catch (FileNotFoundException e) {
31                System.out.print("The file " + fname +" doesn't exists\n");
32                e.printStackTrace();
33            }
34        }
35
36        return br;
37    }
```

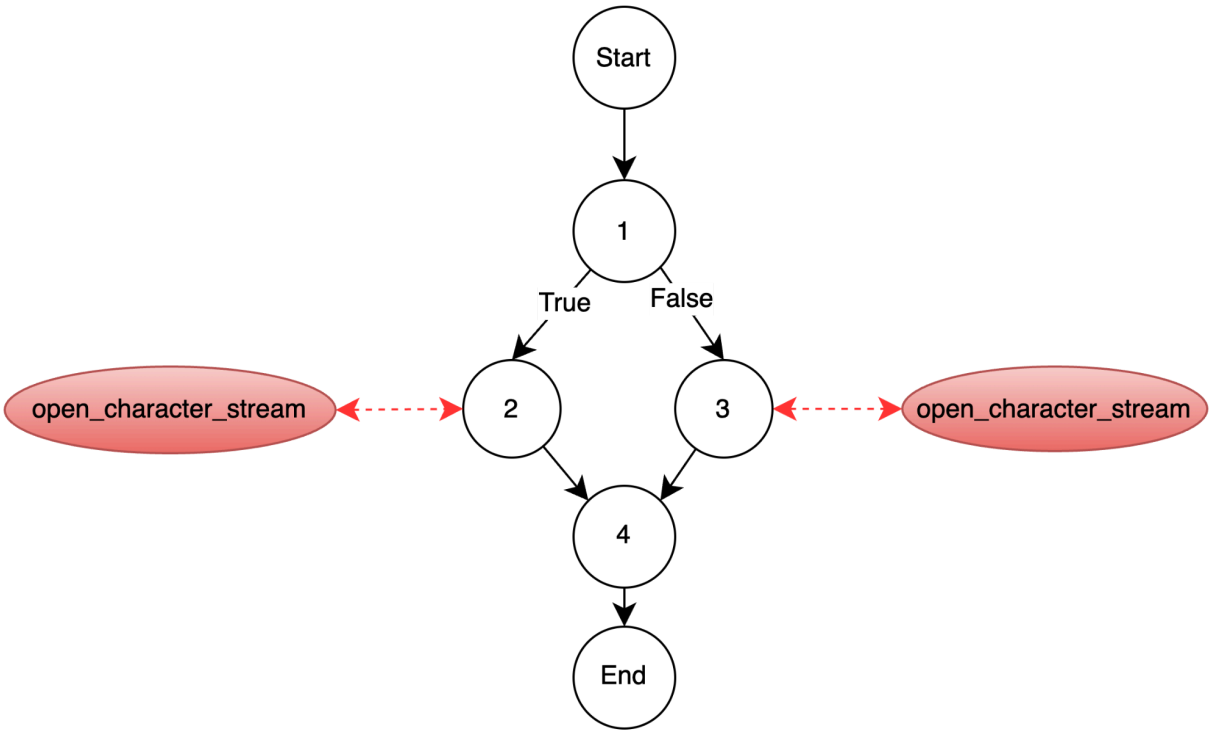
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 23,24 | 23 | 24 | |
| 2 | 25 | 25 | 25 | |
| 3 | 28,29 | 28 | 29 | |
| 4 | 36 | 36 | 36 | |




2. **BufferedReader open_token_stream(String fname):**

```
77      BufferedReader open_token_stream(String fname)
78      {
79          BufferedReader br;
80      if(fname==null || fname.equals(""))
81          br=open_character_stream(null);
82       else
83          br=open_character_stream(fname);
84       return br;
85      }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 79,80 | 79 | 80 | |
| 2 | 81 | 81 | 81 | open_character_stream |
| 3 | 83 | 83 | 83 | open_character_stream |
| 4 | 84 | 84 | 84 | |



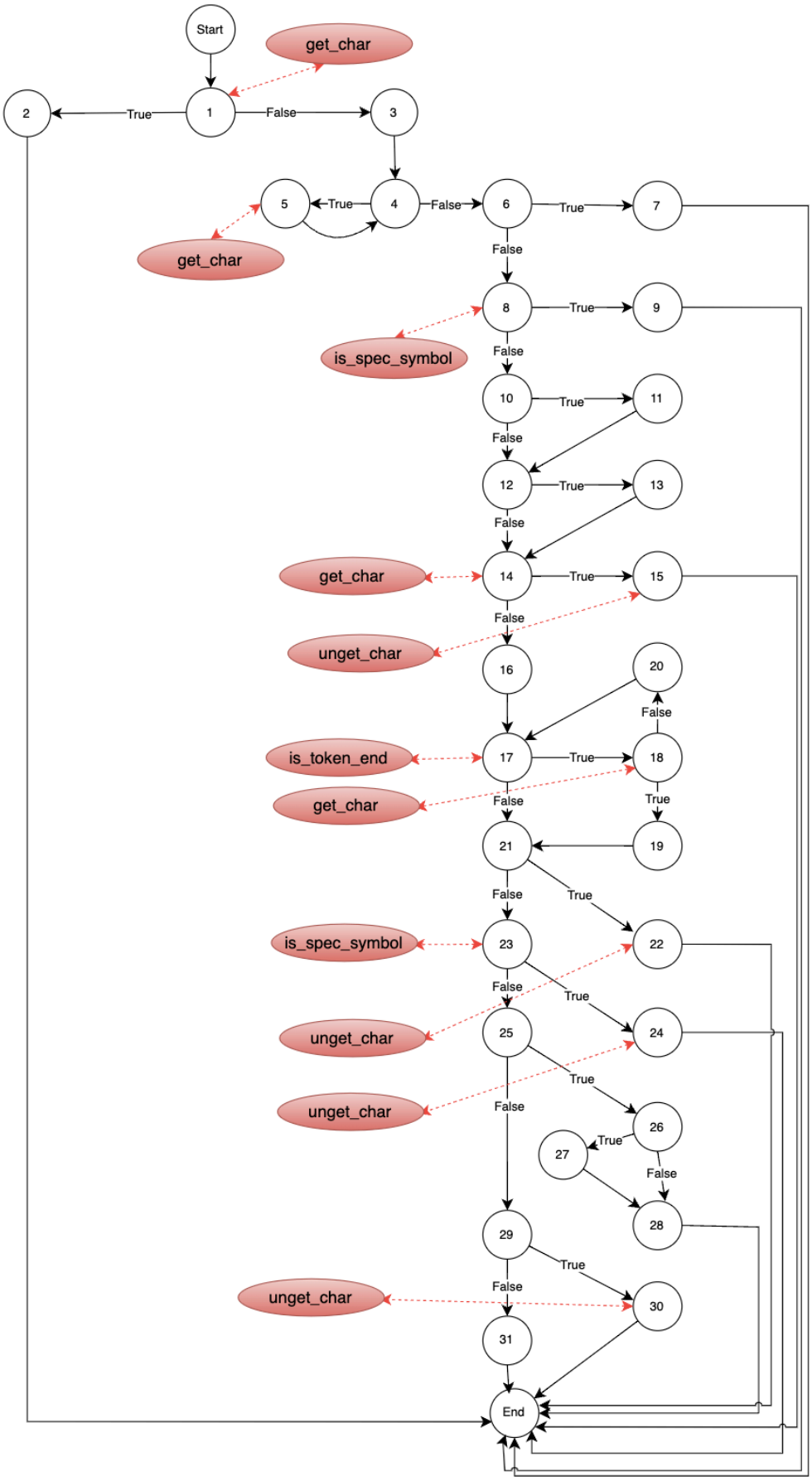

### 3. String get_token(BufferedReader br):

```
94    String get_token(BufferedReader br)
95    {
96      int i=0,j;
97      int id=0;
98      int res = 0;
99      char ch = '\0';
100
101     StringBuilder sb = new StringBuilder();
102
103      try {
104          res = get_char(br);
105          if (res == -1) {
106              return null;
107          }
108          ch = (char)res;
109         while(ch==' '||ch=='\n' || ch == '\r')
110         {
111           res = get_char(br);
112           ch = (char)res;
113         }
114
115      if(res == -1)return null;
116      sb.append(ch);
117      if(is_spec_symbol(ch)==true)return sb.toString();
118      if(ch =='"')id=2;    /* prepare for string */
119      if(ch ==59)id=1;    /* prepare for comment */
120
121      res = get_char(br);
122      if (res == -1) {
123          unget_char(ch,br);
124          return sb.toString();
125      }
126      ch = (char)res;
```

```
128         while (is_token_end(id,res) == false)/* until meet the end character */
129         {
130             sb.append(ch);
131             br.mark(4);
132             res = get_char(br);
133             if (res == -1) {
134                 break;
135             }
136             ch = (char)res;
137         }
138 
139         if(res == -1)       /* if end character is eof token    */
140            { unget_char(ch,br);        /* then put back eof on token_stream */
141              return sb.toString();
142            }
143 
144         if(is_spec_symbol(ch)==true)     /* if end character is special_symbol */
145            { unget_char(ch,br);        /* then put back this character       */
146              return sb.toString();
147            }
148         if(id==1)                   /* if end character is " and is string */
149           {
150             if (ch == '"') {
151                 sb.append(ch);
152             }
153             return sb.toString();
154           }
155         if(id==0 && ch==59)
156                                        /* when not in string or comment,meet ";" */
157           { unget_char(ch,br);       /* then put back this character         */
158             return sb.toString();
159           }
160     } catch (IOException e) {
161         e.printStackTrace();
162     }
163 
164         return sb.toString();                   /* return nomal case token             */
165     }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 96,97,98,99, 101,104,105 | 96 | 105 | get_char |
| 2 | 106 | 106 | 106 | |
| 3 | 108 | 108 | 108 | |
| 4 | 109 | 109 | 109 | |
| 5 | 111,112 | 111 | 112 | get_char |
| 6 | 115a | 115a | 115a | |
| 7 | 115b | 115b | 115b | |
| 8 | 116,117a | 116 | 117a | is_spec_symbol |

| | | | | |
|---|---|---|---|---|
| 9 | 117b | 117b | 117b | |
| 10 | 118a | 118a | 118a | |
| 11 | 118b | 118b | 118b | |
| 12 | 119a | 119a | 119a | |
| 13 | 119b | 119b | 119b | |
| 14 | 121,122 | 121 | 122 | get_char |
| 15 | 123,124 | 123 | 124 | unget_char |
| 16 | 126 | 126 | 126 | |
| 17 | 128 | 128 | 128 | is_token_end |
| 18 | 130,131,132, 133 | 130 | 133 | get_char |
| 19 | 134 | 134 | 134 | |
| 20 | 136 | 136 | 136 | |
| 21 | 139 | 139 | 139 | |
| 22 | 140,141 | 140 | 141 | unget_char |
| 23 | 144 | 144 | 144 | is_spec_symbol |
| 24 | 145,146 | 145 | 146 | unget_char |
| 25 | 148 | 148 | 148 | |
| 26 | 150 | 150 | 150 | |
| 27 | 151 | 151 | 151 | |
| 28 | 153 | 153 | 153 | |
| 29 | 155 | 155 | 155 | |
| 30 | 157,158 | 157 | 158 | unget_char |
| 31 | 164 | 164 | 164 | |

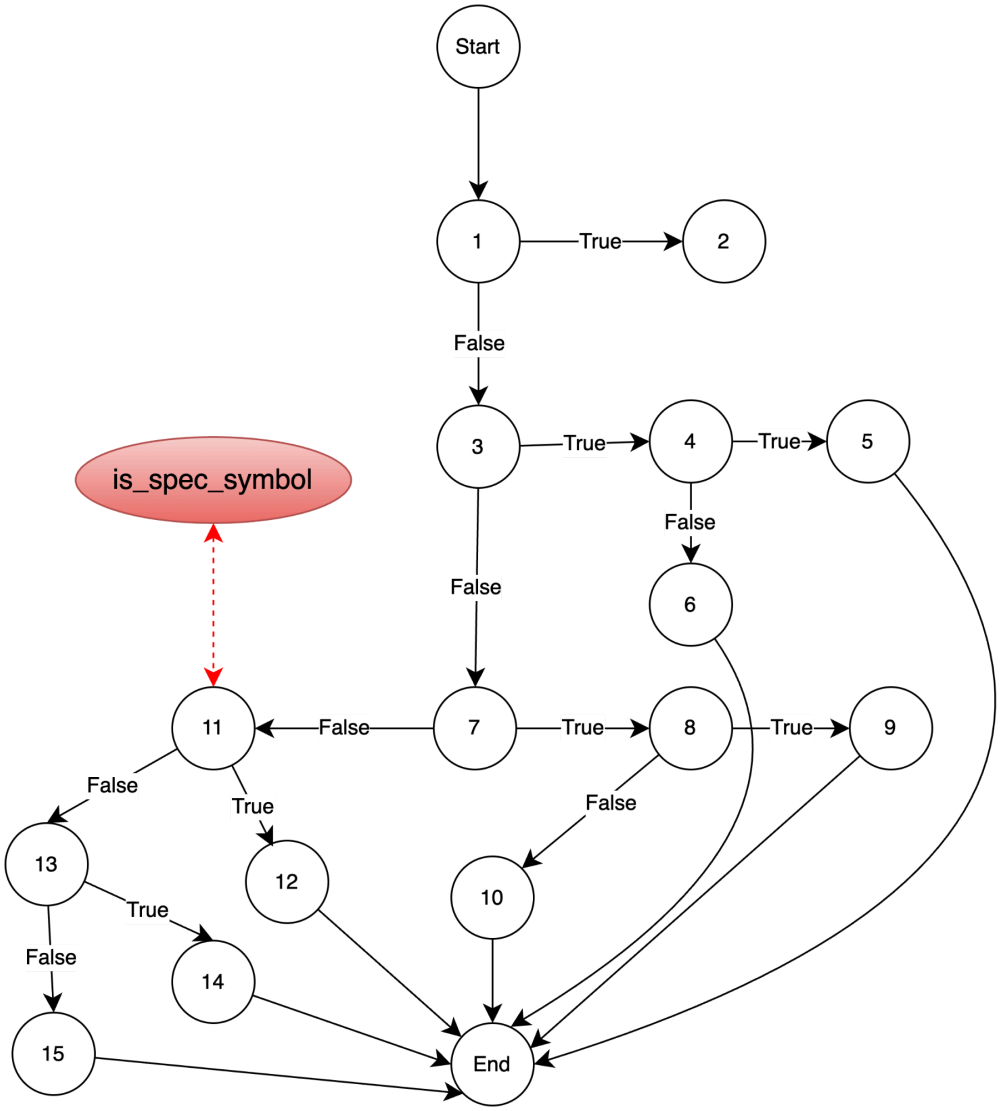

Start
get_char
1
2
True
False
3
4
5
True
False
6
True
7
get_char
False
8
True
9
is_spec_symbol
False
10
True
11
False
12
True
13
False
get_char
14
True
15
False
unget_char
16
20
False
is_token_end
17
True
18
get_char
False
True
21
19
False
True
is_spec_symbol
23
22
False
True
unget_char
25
24
True
unget_char
False
26
True
27
False
28
29
True
unget_char
False
30
31
End

4. **boolean is_token_end(int str_com_id, int res):**

```
172     static boolean is_token_end(int str_com_id, int res)
173     {
174      if(res==-1)return(true); /* is eof token? */
175      char ch = (char)res;
176      if(str_com_id==1)          /* is string token */
177         { if(ch=='"' || ch=='\n' || ch == '\r' || ch=='\t')   /* for string until meet a
178              return true;
179           else
180              return false;
181         }
182
183      if(str_com_id==2)    /* is comment token */
184        { if(ch=='\n' || ch == '\r' || ch=='\t')     /* for comment until meet end of lir
185             return true;
186           else
187             return false;
188        }
189
190      if(is_spec_symbol(ch)==true) return true; /* is special_symbol? */
191      if(ch ==' ' || ch=='\n'|| ch=='\r' || ch==59) return true;
192                                  /* others until meet blank or tab or 59 */
193      return false;               /* other case,return FALSE */
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 174a | 174a | 174a | |
| 2 | 174b | 174b | 174b | |
| 3 | 175, 176 | 175 | 176 | |
| 4 | 177 | 177 | 177 | |
| 5 | 178 | 178 | 178 | |
| 6 | 180 | 180 | 180 | |
| 7 | 183 | 183 | 183 | |
| 8 | 184 | 184 | 184 | |
| 9 | 185 | 185 | 185 | |
| 10 | 187 | 187 | 187 | |
| 11 | 190a | 190a | 190a | is_spec_symbol |
| 12 | 190b | 190b | 190b | |
| 13 | 191a | 191a | 191a | |

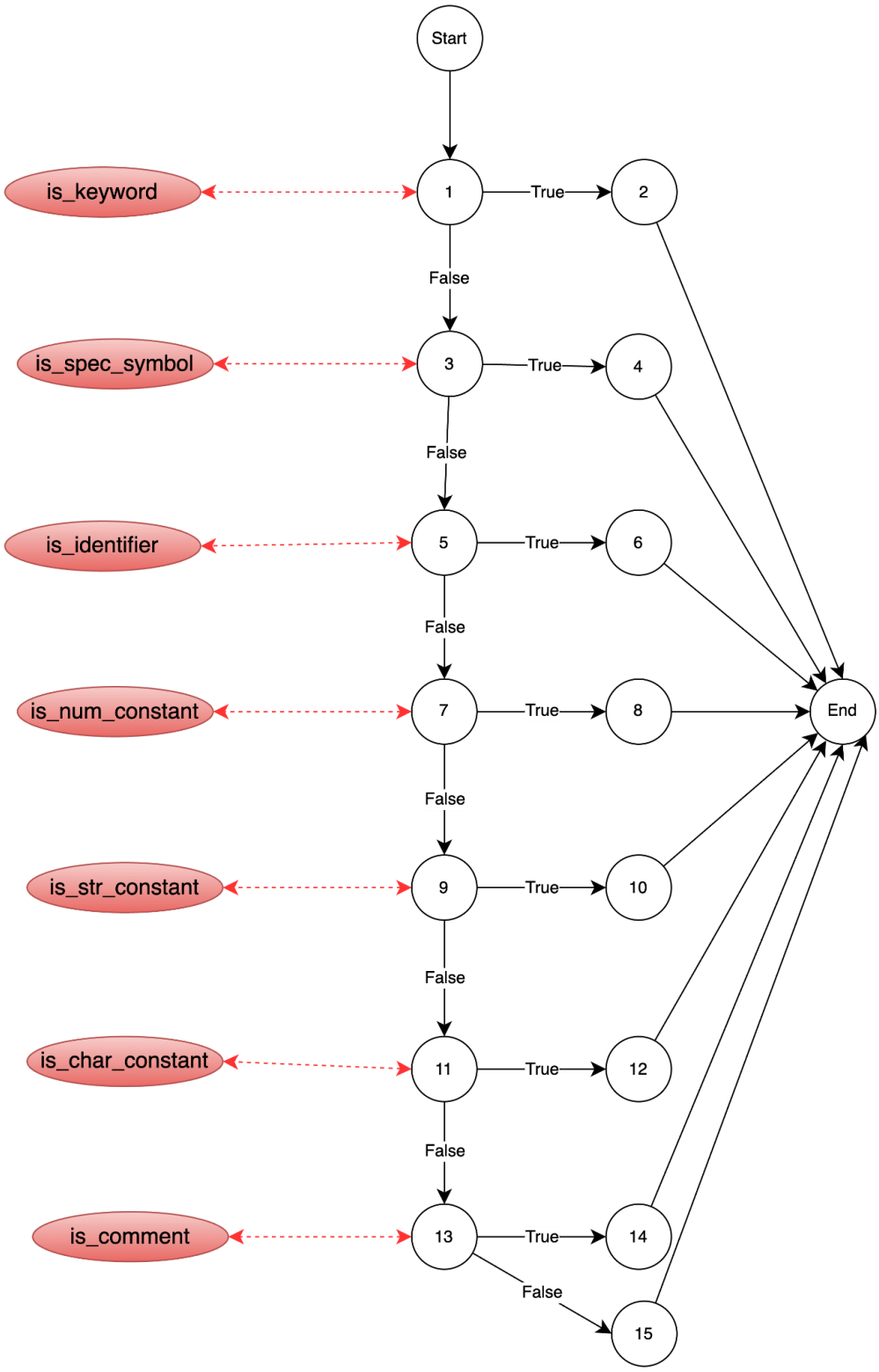
| | | | | |
|---|---|---|---|---|
| 14 | 191b | 191b | 191b | |
| 15 | 193 | 193 | 193 | |



5. **int token_type(String tok):**

```
203     static int token_type(String tok)
204     {
205      if(is_keyword(tok))return(keyword);
206      if(is_spec_symbol(tok.charAt(0)))return(spec_symbol);
207      if(is_identifier(tok))return(identifier);
208      if(is_num_constant(tok))return(num_constant);
209      if(is_str_constant(tok))return(str_constant);
210      if(is_char_constant(tok))return(char_constant);
211      if(is_comment(tok))return(comment);
212      return(error);                    /* else look as error token */
213     }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 205a | 205a | 205a | is_keyword |
| 2 | 205b | 205b | 205b | |
| 3 | 206a | 206a | 206a | is_spec_symbol |
| 4 | 206b | 206b | 206b | |
| 5 | 207a | 207a | 207a | is_identifier |
| 6 | 207b | 207b | 207b | |
| 7 | 208a | 208a | 208a | is_num_constant |
| 8 | 208b | 208b | 208b | |
| 9 | 209a | 209a | 209a | is_str_constant |
| 10 | 209b | 209b | 209b | |
| 11 | 210a | 210a | 210a | is_char_constant |
| 12 | 210b | 210b | 210b | |
| 13 | 211a | 211a | 211a | is_comment |
| 14 | 211b | 211b | 211b | |
| 15 | 212 | 212 | 212 | |

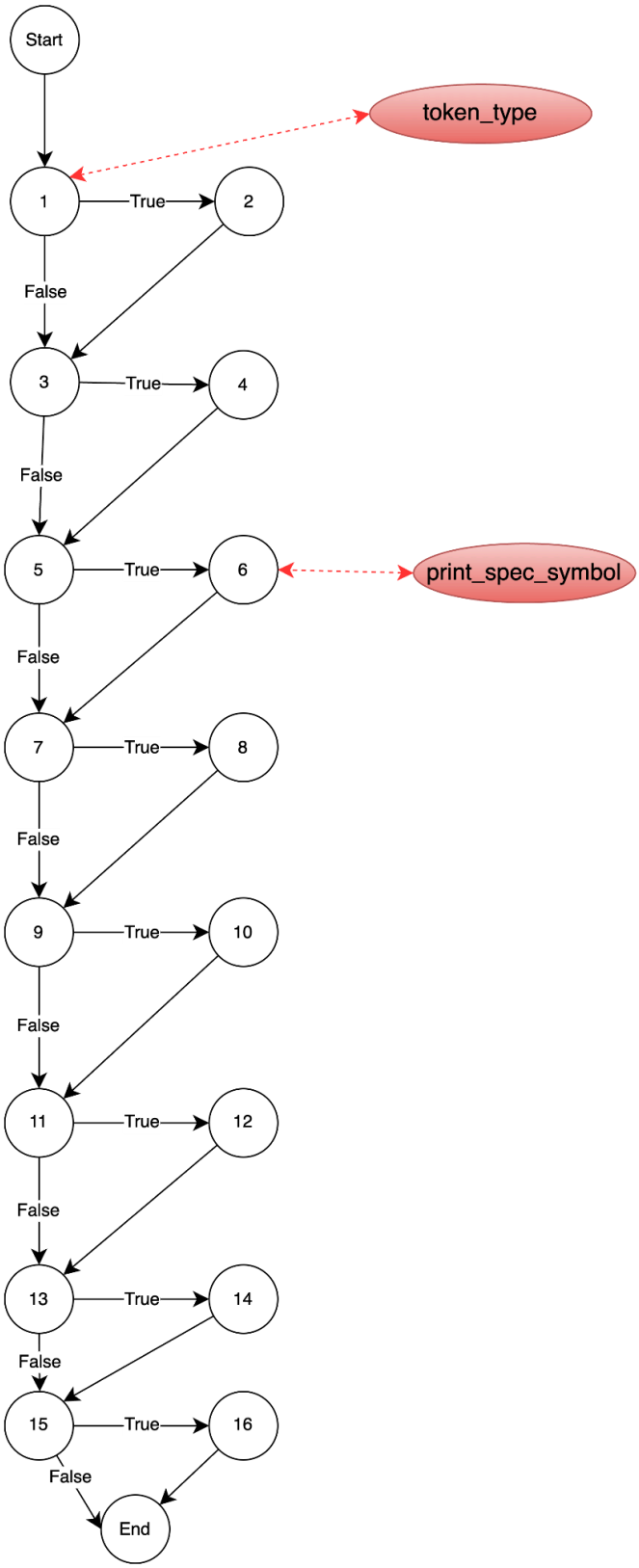

Start
is_keyword
1
True
2
False
is_spec_symbol
3
True
4
False
is_identifier
5
True
6
False
is_num_constant
7
True
8
End
False
is_str_constant
9
True
10
False
is_char_constant
11
True
12
False
is_comment
13
True
14
False
15

6. **void print_token(String tok):**

```
219     void print_token(String tok)
220     { int type;
221       type=token_type(tok);
222      if(type==error)
223        {
224         System.out.print("error,\"" + tok + "\".\n");
225        }
226
227      if(type==keyword)
228        {
229        System.out.print("keyword,\"" + tok + "\".\n");
230        }
231
232      if(type==spec_symbol)print_spec_symbol(tok);
233      if(type==identifier)
234        {
235        System.out.print("identifier,\"" + tok + "\".\n");
236        }
237      if(type==num_constant)
238        {
239        System.out.print("numeric," + tok + ".\n");
240        }
241      if(type==str_constant)
242        {
243        System.out.print("string," + tok + ".\n");
244        }
245      if(type==char_constant)
246        {
247         System.out.print("character,\"" + tok.charAt(1) + "\".\n");
248        }
249      if(type==comment)
250        {
251         System.out.print("comment,\"" + tok + "\".\n");
252        }
253    }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 220,221,222 | 220 | 222 | token_type |
| 2 | 224 | 224 | 224 | |
| 3 | 227 | 227 | 227 | |
| 4 | 229 | 229 | 229 | |
| 5 | 232a | 232a | 232a | |

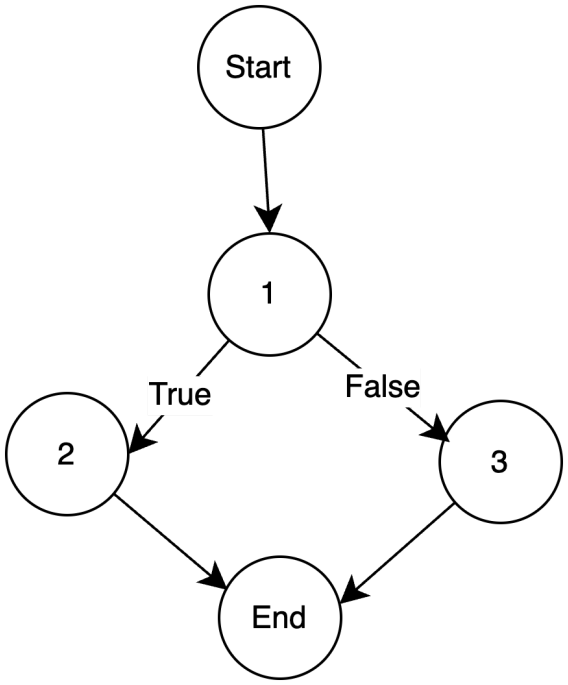
| | | | | |
|---|---|---|---|---|
| 6 | 232b | 232b | 232b | print_spec_symbol |
| 7 | 233 | 233 | 233 | |
| 8 | 235 | 235 | 235 | |
| 9 | 237 | 237 | 237 | |
| 10 | 239 | 239 | 239 | |
| 11 | 241 | 241 | 241 | |
| 12 | 243 | 243 | 243 | |
| 13 | 245 | 245 | 245 | |
| 14 | 247 | 247 | 247 | |
| 15 | 249 | 249 | 249 | |
| 16 | 251 | 251 | 251 | |


Start
token_type
1
True
2
False
3
True
4
False
5
True
6
print_spec_symbol
False
7
True
8
False
9
True
10
False
11
True
12
False
13
True
14
False
15
True
16
False
End

7. **boolean is_comment(String ident):**

```
263     static boolean is_comment(String ident)
264     {
265       if( ident.charAt(0) ==59 )   /* the char is 59   */
266          return true;
267       else
268          return false;
269     }
```

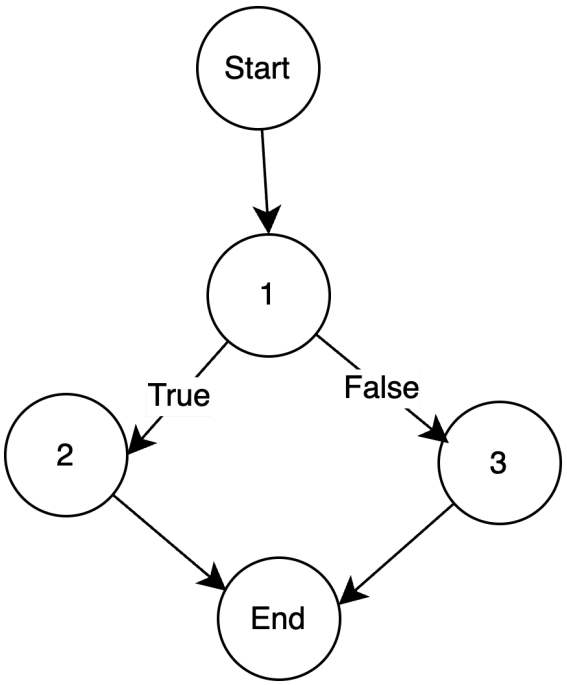
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 265 | 265 | 265 | |
| 2 | 266 | 266 | 266 | |
| 3 | 268 | 268 | 268 | |



8. **boolean is_keyword(String str):**

```
276    static boolean is_keyword(String str)
277    {
278     if (str.equals("and") || str.equals("or") || str.equals("if") ||
279             str.equals("xor")||str.equals("lambda")||str.equals("=>"))
280          return true;
281      else
282          return false;
283    }
```

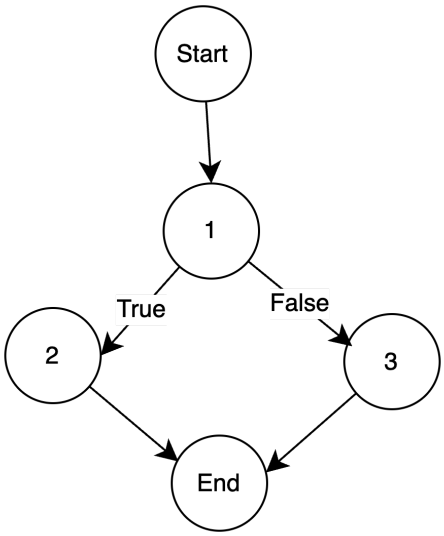
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 278, 279 | 278 | 279 | |
| 2 | 280 | 280 | 280 | |
| 3 | 282 | 282 | 282 | |



9. **boolean is_char_constant(String str):**

```
290    static boolean is_char_constant(String str)
291    {
292      if (str.length() > 2 || str.charAt(0)=='#' && Character.isLetter(str.charAt(1)))
293         return true;
294      else
295         return false;
296    }
```

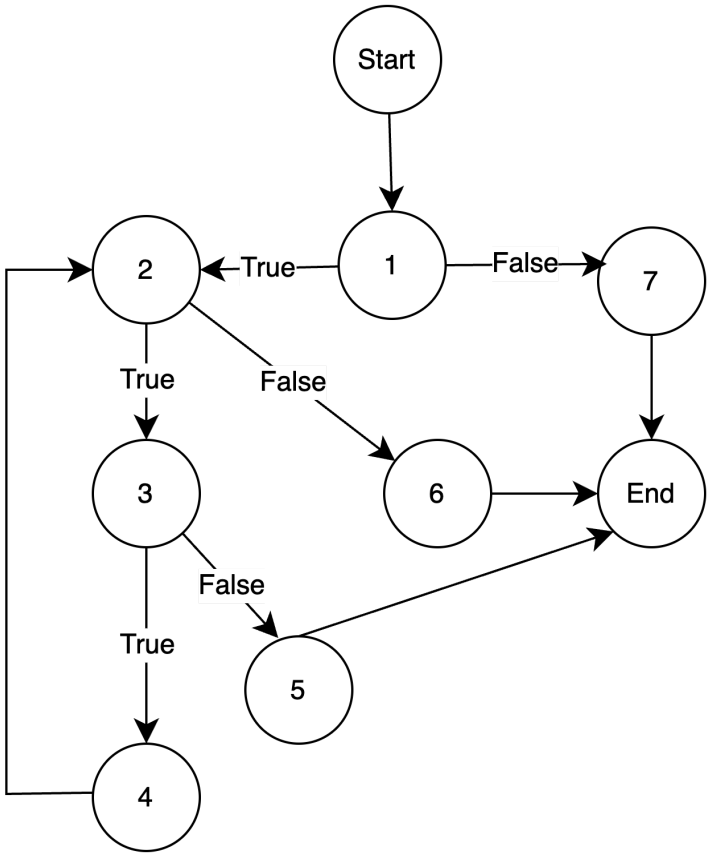
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 292 | 292 | 292 | |
| 2 | 293 | 293 | 293 | |
| 3 | 295 | 295 | 295 | |




10. **boolean is_num_constant(String str):**

```
303    static boolean is_num_constant(String str)
304    {
305      int i=1;
306
307      if ( Character.isDigit(str.charAt(0)))
308        {
309        while ( i < str.length() && str.charAt(i) != '\0' )
310          {
311           if(Character.isDigit(str.charAt(i+1)))
312             i++;
313           else
314             return false;
315          }                          /* end WHILE */
316        return true;
317        }
318      else
319       return false;               /* other return FALSE */
320    }
```

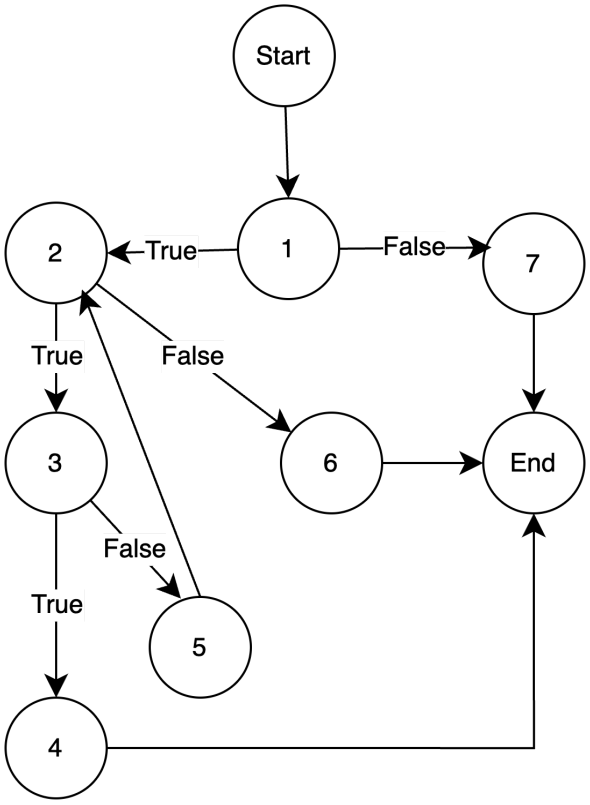
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 305, 307 | 305 | 307 | |
| 2 | 309 | 309 | 309 | |
| 3 | 311 | 311 | 311 | |
| 4 | 312 | 312 | 312 | |
| 5 | 314 | 314 | 314 | |
| 6 | 316 | 316 | 316 | |
| 7 | 319 | 319 | 319 | |



11. **boolean is_str_constant(String str):**

```
327    static boolean is_str_constant(String str)
328    {
329      int i=1;
330
331      if ( str.charAt(0) =='"')
332         { while (i < str.length() && str.charAt(i)!='\0')
333             { if(str.charAt(i)=='"' )
334                  return true;        /* meet the second '"'          */
335               else
336               i++;
337             }               /* end WHILE */
338         return true;
339        }
340      else
341        return false;       /* other return FALSE */
342    }
```

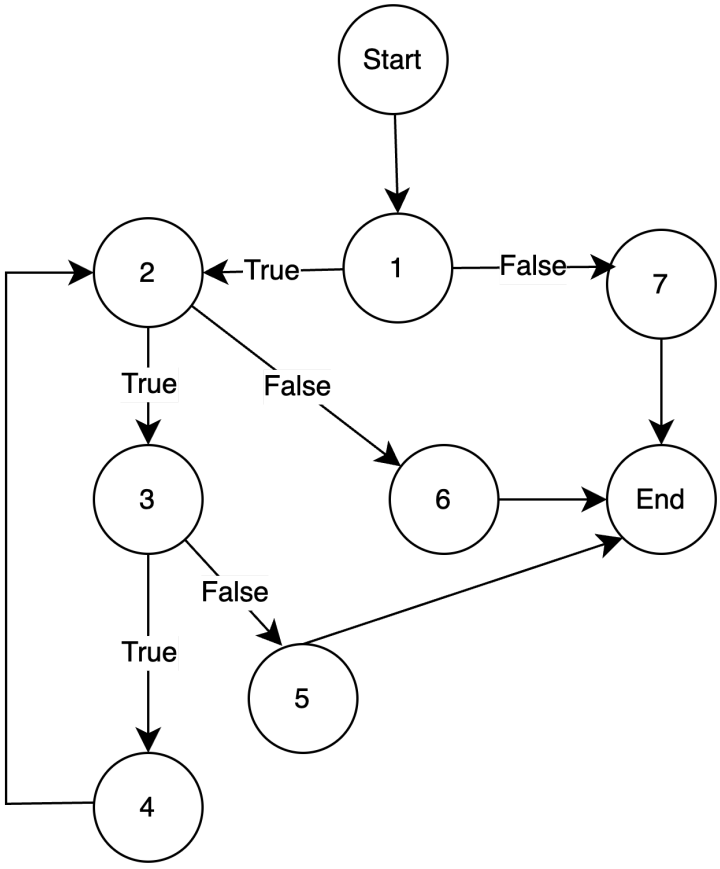
| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 329, 331 | 305 | 307 | |
| 2 | 332 | 309 | 309 | |
| 3 | 333 | 311 | 311 | |
| 4 | 334 | 312 | 312 | |
| 5 | 336 | 314 | 314 | |
| 6 | 338 | 316 | 316 | |
| 7 | 341 | 319 | 319 | |




**12. boolean is_identifier(String str):**

```
349    static boolean is_identifier(String str)
350    {
351      int i=1;
352
353      if ( Character.isLetter(str.charAt(0)) )
354         {
355            while(i < str.length() && str.charAt(i) !='\0' )   /* unti meet the end token sign */
356               {
357                if(Character.isLetter(str.charAt(i)) || Character.isDigit(str.charAt(i)))
358                   i++;
359                else
360                   return false;
361               }      /* end WHILE */
362            return false;
363         }
364      else
365        return true;
366    }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 351, 353 | 351 | 353 | |
| 2 | 355 | 355 | 355 | |
| 3 | 357 | 357 | 357 | |
| 4 | 358 | 358 | 358 | |
| 5 | 360 | 360 | 360 | |
| 6 | 362 | 362 | 362 | |
| 7 | 365 | 365 | 365 | |

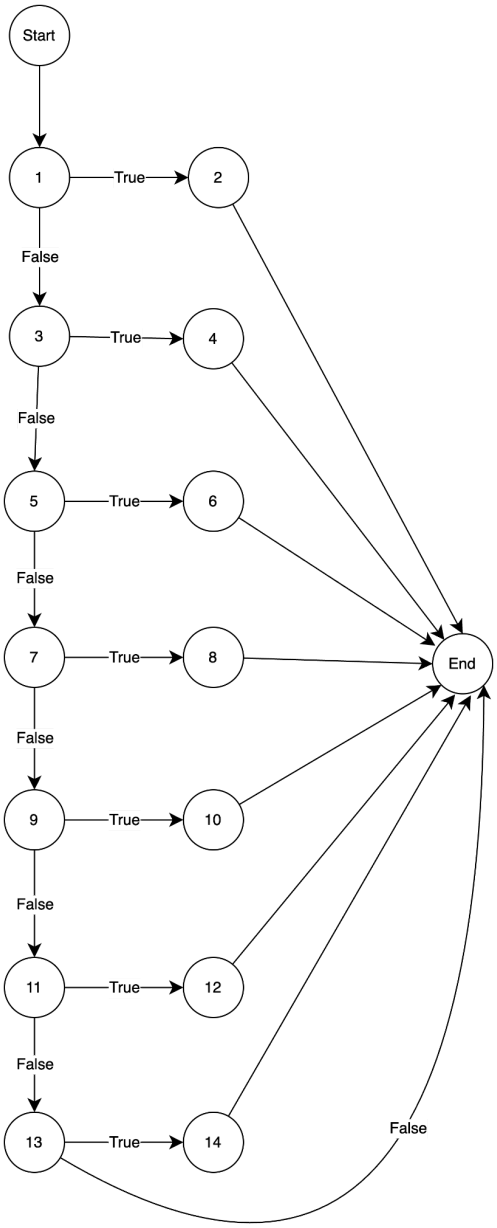


**13. void print_spec_symbol(String str):**

```
376    static void print_spec_symbol(String str)
377    {
378        if      (str.equals(")"))
379        {
380
381                 System.out.print("lparen.\n");
382                 return;
383        }
384        if (str.equals(")"))
385        {
386
387                 System.out.print("rparen.\n");
388                 return;
389        }
390        if (str.equals("["))
391        {
392                 System.out.print("lsquare.\n");
393                 return;
394        }
395        if (str.equals("]"))
396        {
397
398                 System.out.print("rsquare.\n");
399                 return;
400        }
401        if (str.equals("'"))
402        {
403                 System.out.print("quote.\n");
404                 return;
405        }
406        if (str.equals("`"))
407        {
408
409                 System.out.print("bquote.\n");
410                 return;
411        }
412
413        if (str.equals(","))
414        {
415                 System.out.print("comma.\n");
416                 return;
417        }
418    }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 378 | 378 | 378 | |
| 2 | 381, 382 | 381 | 382 | |
| 3 | 384 | 384 | 384 | |
| 4 | 387, 388 | 387 | 388 | |
| 5 | 390 | 390 | 390 | |
| 6 | 392, 393 | 392 | 393 | |
| 7 | 395 | 395 | 395 | |
| 8 | 398, 399 | 398 | 399 | |

| | | | | |
|---|---|---|---|---|
| 9 | 401 | 401 | 401 | |
| 10 | 403, 404 | 403 | 404 | |
| 11 | 406 | 406 | 406 | |
| 12 | 409, 410 | 409 | 410 | |
| 13 | 413 | 413 | 413 | |
| 14 | 415, 416 | 415 | 416 | |

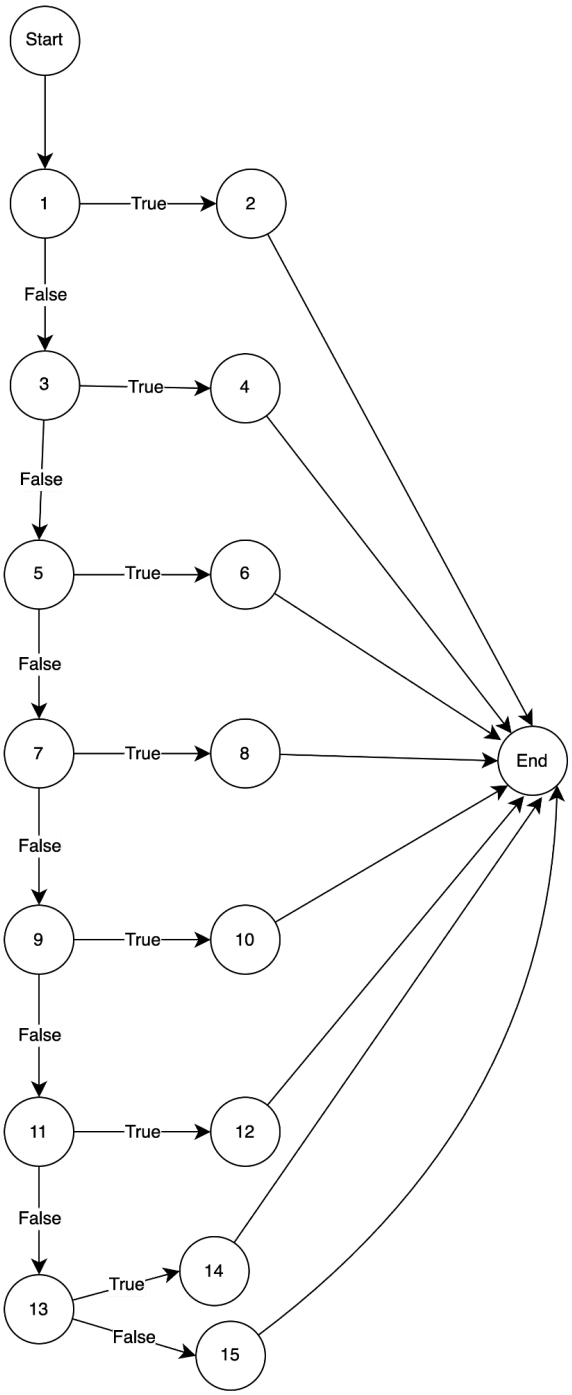


**14. boolean is_spec_symbol(char c):**

```
425     static boolean is_spec_symbol(char c)
426     {
427         if (c == '(')
428         {
429             return true;
430         }
431         if (c == ')')
432         {
433             return true;
434         }
435         if (c == '[')
436         {
437             return true;
438         }
439         if (c == ']')
440         {
441             return true;
442         }
443         if (c == '/')
444         {
445             return true;
446         }
447         if (c == '`')
448         {
449             return true;
450         }
451         if (c == ',')
452         {
453             return true;
454         }
455         return false;     /* others return FALSE */
456     }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 427 | 427 | 427 | |
| 2 | 429 | 429 | 429 | |
| 3 | 431 | 431 | 431 | |
| 4 | 433 | 433 | 433 | |
| 5 | 435 | 435 | 435 | |
| 6 | 437 | 437 | 437 | |
| 7 | 439 | 439 | 439 | |
| 8 | 441 | 441 | 441 | |
| 9 | 443 | 443 | 443 | |
| 10 | 445 | 445 | 445 | |
| 11 | 447 | 447 | 447 | |

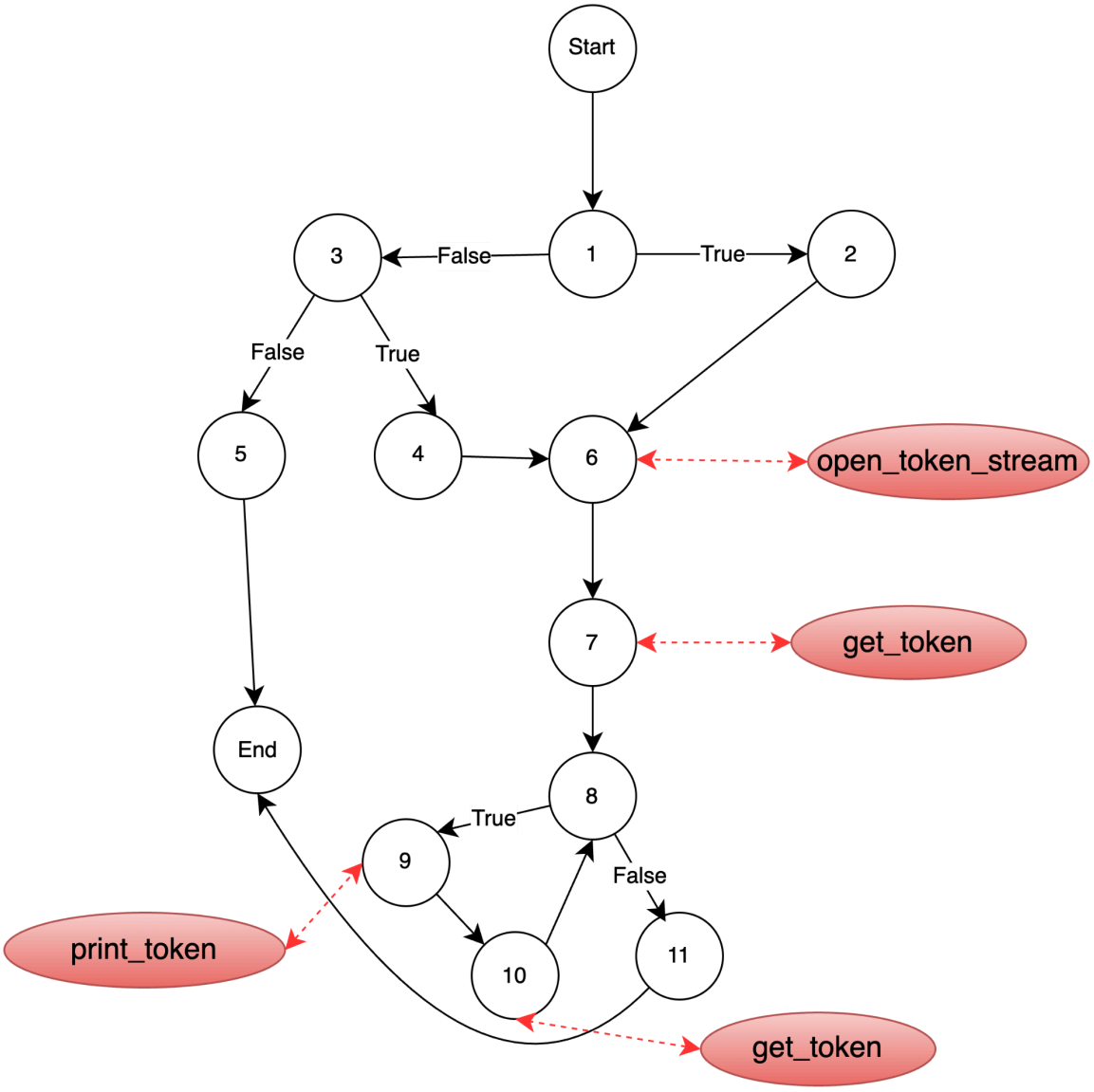
| | | | | |
|---|---|---|---|---|
| 12 | 449 | 449 | 449 | |
| 13 | 451 | 451 | 451 | |
| 14 | 453 | 453 | 453 | |
| 15 | 455 | 455 | 455 | |



**15. void main(String[] args):**

```
458     public static void main(String[] args)  {
459         String fname = null;
460         if (args.length == 0) { /* if not given filename,take as '""' */
461             fname = new String();
462         } else if (args.length == 1) {
463             fname = args[0];
464         } else {
465             System.out.print("Error! Please give the token stream\n");
466             System.exit(0);
467         }
468         Printtokens t = new Printtokens();
469         BufferedReader br = t.open_token_stream(fname); /* open token stream */
470         String tok = t.get_token(br);
471         while (tok != null) {   /* take one token each time until eof */
472             t.print_token(tok);
473             tok = t.get_token(br);
474 
475         }
476 
477         System.exit(0);
478     }
```

| Block Number | Lines | Entry | Exit | Function calls |
|---|---|---|---|---|
| 1 | 459, 460 | 459 | 460 | |
| 2 | 461 | 461 | 461 | |
| 3 | 462 | 462 | 462 | |
| 4 | 463 | 463 | 463 | |
| 5 | 465, 466 | 465 | 466 | |
| 6 | 468, 469 | 468 | 469 | open_token_stream |
| 7 | 470 | 470 | 470 | get_token |
| 8 | 471 | 471 | 471 | |
| 9 | 472 | 472 | 472 | print_token |
| 10 | 473 | 473 | 473 | get_token |
| 11 | 477 | 477 | 477 | |


Start
1
False
True
3
2
False
True
5
4
6
open_token_stream
7
get_token
End
8
True
9
False
print_token
10
11
get_token