Algorithm Design

An algorithm can be written out in pseudo code

Algorithm 2: Bernoulli Trials Attribute Selection

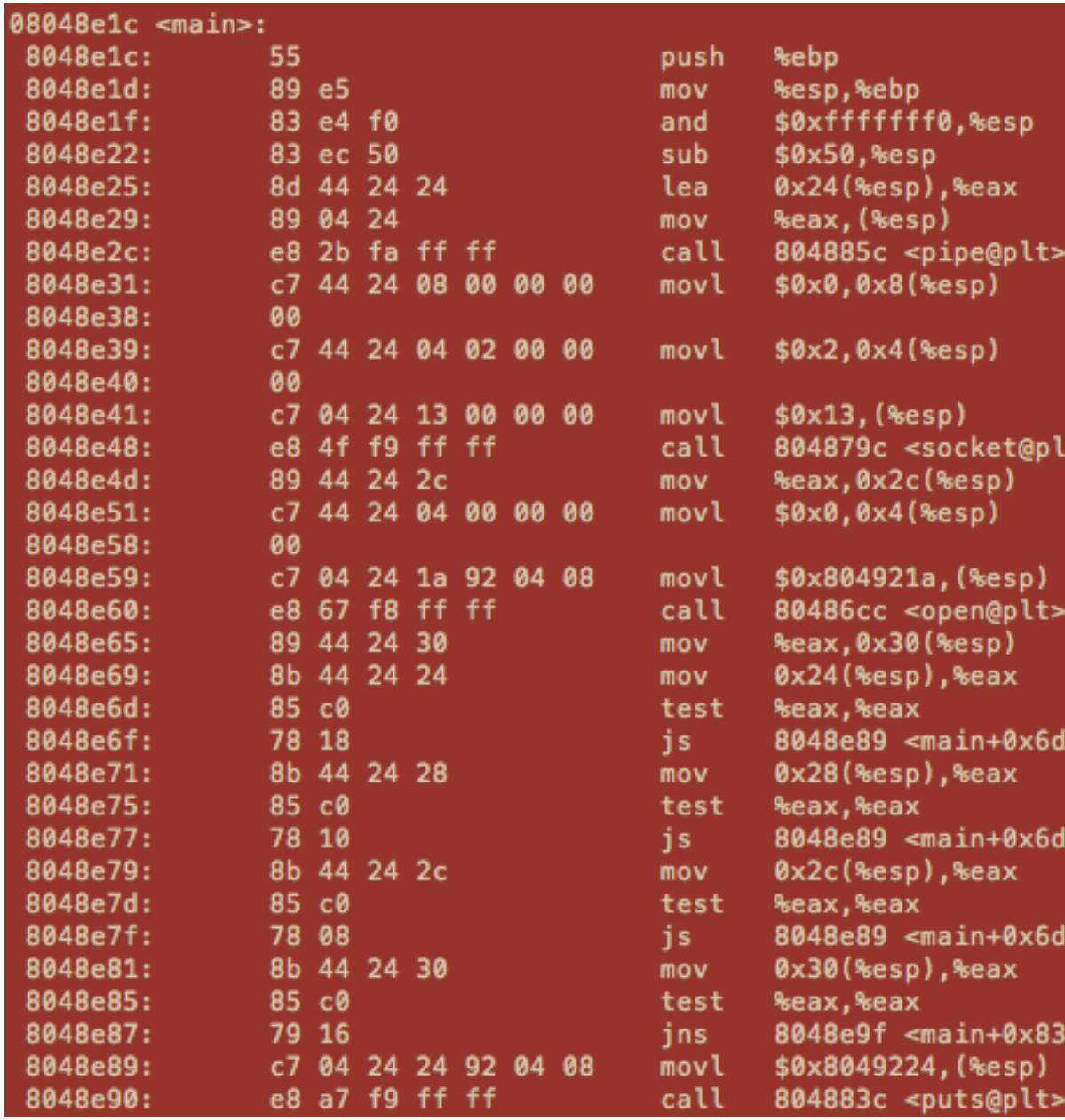
Input: Classifier L
Attributes A
Output: Attribute subset A^s

1 $r_{min} = 0$, $r_{max} = |A|$, $A^s = A$, $success = 0$, $fail = 0$
2 Compute tables: $T_{sum}(n, r)$ for $r_{min} \leq r < r_{max}$
3 $k_{opt}(n, r)$ for $r_{min} \leq r < r_{max}$
4 threshold = $\frac{1}{n}(\sum_{i=1}^{n} \epsilon(L, A))$
5 $\Longrightarrow$ Start in states 1 or 2
6 **while** $r \leq |A^s|$ **do**
7 $k = K_{opt}(|A^s|, r)$
8 A^k = Select k attributes at random from A^s wi
$\epsilon(A_i^s) <$ threshold
9 $e = \epsilon(L, A^s)$ // Current er
10 $e' = \epsilon(L, A^s - A^k)$ // Future err
11 **if** $e' \leq e$ **then**
12 $A^s = A^s - A^k$ // If error didn't go
13 $success++$
14 $fail = 0$
15 **else**
16 $fail++$
17 $success = 0$
18 **if** $fail \geq N^-(A, A^s, k)$ **then**
19 // Failed more than expected
20 **if** $(r_{min} \pm 1 = r_{max})$ **then**
21 $\Longrightarrow$ Recover in case of state 1 or 3
22 $r_{min} = 0$ // Recursive sea
23 $r_{max} = |A^s|$

Then turned into source code

```
for (var $docid in results) {

    var doc = results[$docid];

   var authorName = $($($(doc).find("author")).
  // $("#arxiv-data").append(authorName);
    //alert(authorName);
    var authorAff = $($($(doc).find("author")).


    var paperTitle = $($(doc).find("title")).te
    var paperURL = $($(doc).find("id")).text();

    var paperAbstract = $($(doc).find("summary"

    var paperUpdateTime = $($(doc).find("update

    // filter out metadata
    if (paperTitle.indexOf("ArXiv") == -1)
    codeAddress(authorName, authorAff, paperTit

}
```

Which is then compiled to machine code



```
08048e1c <main>:
 8048e1c:       55                      push   %ebp
 8048e1d:       89 e5                   mov    %esp,%ebp
 8048e1f:       83 e4 f0                and    $0xfffffff0,%esp
 8048e22:       83 ec 50                sub    $0x50,%esp
 8048e25:       8d 44 24 24             lea    0x24(%esp),%eax
 8048e29:       89 04 24                mov    %eax,(%esp)
 8048e2c:       e8 2b fa ff ff          call   804885c <pipe@plt>
 8048e31:       c7 44 24 08 00 00 00    movl   $0x0,0x8(%esp)
 8048e38:       00
 8048e39:       c7 44 24 04 02 00 00    movl   $0x2,0x4(%esp)
 8048e40:       00
 8048e41:       c7 04 24 13 00 00 00    movl   $0x13,(%esp)
 8048e48:       e8 4f f9 ff ff          call   804879c <socket@pl
 8048e4d:       89 44 24 2c             mov    %eax,0x2c(%esp)
 8048e51:       c7 44 24 04 00 00 00    movl   $0x0,0x4(%esp)
 8048e58:       00
 8048e59:       c7 04 24 1a 92 04 08    movl   $0x804921a,(%esp)
 8048e60:       e8 67 f8 ff ff          call   80486cc <open@plt>
 8048e65:       89 44 24 30             mov    %eax,0x30(%esp)
 8048e69:       8b 44 24 24             mov    0x24(%esp),%eax
 8048e6d:       85 c0                   test   %eax,%eax
 8048e6f:       78 18                   js     8048e89 <main+0x6d
 8048e71:       8b 44 24 28             mov    0x28(%esp),%eax
 8048e75:       85 c0                   test   %eax,%eax
 8048e77:       78 10                   js     8048e89 <main+0x6d
 8048e79:       8b 44 24 2c             mov    0x2c(%esp),%eax
 8048e7d:       85 c0                   test   %eax,%eax
 8048e7f:       78 08                   js     8048e89 <main+0x6d
 8048e81:       8b 44 24 30             mov    0x30(%esp),%eax
 8048e85:       85 c0                   test   %eax,%eax
 8048e87:       79 16                   jns    8048e9f <main+0x83
 8048e89:       c7 04 24 24 92 04 08    movl   $0x8049224,(%esp)
 8048e90:       e8 a7 f9 ff ff          call   804883c <puts@plt>
```

Problem Solving

- Algorithm: set of unambiguous instructions to solve a problem
  - Breaking down a problem into a set of sub-problems
  - Example: Toast some bread

- Without instructions – computers cannot do anything at all!

Algorithm design

- Analysis and specification
  - *Analyze*: Understand/define the problem
  - *Specify*: Specify particulars
- Algorithm development phase
  - *Develop*: Logical sequence of steps
  - *Test*: Follow outline, test cases
- Implementation phase
  - *Code*: The steps into a programming language
  - *Test*: Debug
- Maintenance phase
  - *Use* the program
  - *Maintain*: Correct errors, meet changing requirements

An example:

Making a perfect piece of toast

What do we need:

a loaf of bread, knife, toaster,
plate, butter, cutting board

An example:

Making a perfect piece of toast

pseudo code

1. Move a *loaf of bread* on a *cutting board*
2. Cut a slice of bread with a *knife*
3. Move the slice of bread to the *toaster*
4. Turn *toaster* on
5. Wait for the *toaster* to finish
6. Move the toasted bread on a *plate*
7. Spread *butter* on the toast with *knife*

An example:

Making a perfect piece of toast

Variables:

A= loaf of bread

K= knife

T= toaster

P= plate

B= butter

CB= cutting board

S= slice of bread

pseudo code

1. move **A** to **CB**
2. cut **S** with **K**
3. move **S** to **T**
4. IF(NOT ON(T))
5. turn on **T**
6. WHILE(NOT TOASTED(**S**))
7. wait for **T**
8. move **S** to **P**
9. spread **B** on **S** with **K**

Basic concepts

- *Instructions* – simple and unambiguous
- *Variables* – input and temporary
- *Subprocedures* – smaller tasks
- *Looping*: `FOR` each variable, `WHILE`
  - Act of repeating tasks
- *Conditional statements*: `IF ELSE`
  - Selectively execute instructions

Basic concepts

IF

Execute some statements based on the truth on a statement

Basic concepts

IF

```
if ( 5 > 0 ) {

print "the statement is true!"

}
```

Basic concepts

IF

```
if ( 5 > 9 ) {

print "the statement is true!"

}
```

Basic concepts

IF

```
a = 5
if ( a > 9 ) {

print "the statement is true!"

}
```

Basic concepts

IF

```
a = 5
if ( a < 9 ) {

print "the statement is true!"

}
```

Basic concepts

WHILE
Execute statements
while a condition is true

Basic concepts

WHILE

```
while ( true ) {

print "in the while loop!"

}
```

Basic concepts

WHILE

```
a = 3
while ( a > 1 ) {

print "in the while loop!"

}
```

Basic concepts

WHILE

```
a = 3
while ( a > 1 ) {

print "in the while loop!"
a--
}
```

Basic concepts

FOR

Execute statements while a condition is true as well as increment and initialize variables

Basic concepts

FOR LOOP

```
for ( var i=0; i < 10 ; i++ ) {

print "loop" + i

}
```

Basic concepts

loop 0
loop 1
loop 2
.
.
.
loop 9

Basic concepts

IF ELSE

Execute some statements if a condition is true otherwise execute different statements

Basic concepts

IF ELSE

```
a = 5
if ( a < 9 ) {
    print "the statement is true!"
}else{
    print "the statement is false!"
}
```

Basic concepts

IF
FOR
WHILE
IF ELSE