

## Notes, 2(a)

ECE 606

### Expressing Algorithms

We adopt a “model of computation” – the kind of computer on which we will run our algorithms.

We’ll keep it informal: single-threaded computer that can execute algorithms we specify as pseudo-code, one “instruction” or “step” at a time.

Our syntax for pseudo-code:

- Every algorithm has inputs, outputs. Either or both may be the empty string.
- Basic data type: integer Here, integer is unbounded, so it's distinct from the notation of `int` in C, which has a constant upper bound.
- Variables, assignment  
Note: I use “ $\leftarrow$ ” for assignment, and “ $=$ ” for equality testing.
- If, While, For
- Subroutines, which themselves are algorithms

We have not said anything about the cost of each “instruction” or “step” yet.

Example 1:

```
ISINARRAY( $A[1, \dots, n]$ ,  $i$ )  
1 foreach  $j$  from 1 to n do  
2   if  $i = A[j]$  then return 1  
3 return 0
```

Example 2:

```
BINSEARCH( $A[0, \dots, n-1]$ ,  $lo$ ,  $hi$ ,  $i$ )  
1 while  $lo \leq hi$  do  
2    $mid \leftarrow \lfloor \frac{lo+hi}{2} \rfloor$   
3   if  $A[mid] = i$  then return true  
4   if  $A[mid] < i$  then  $lo \leftarrow mid + 1$   
5   else  $hi \leftarrow mid - 1$   
6 return false
```

Example 3:

```
RANDMEDIAN( $A[1, \dots, n]$ )  
1 while true do  
2    $i \leftarrow$  uniformly random choice from  $1, \dots, n$   
3    $c \leftarrow 0$   
4   foreach  $j$  from 1 to n do  
5     if  $A[j] < A[i]$  then  $c \leftarrow c + 1$   
6   if  $c = \frac{n-1}{2}$  then return  $i$ 
```