http://www.cs.cornell.edu/courses/cs1110/2020sp

Lecture 25: **Practice Programming** (focus on while-loop)

CS 1110

Introduction to Computing Using Python

[E. Andersen, A. Bracy, D. Fan, D. Gries, L. Lee,
S. Marschner, C. Van Loan, W. White]

Revisit word guessing game

- There is a secret word.
- The user has 10 chances to guess letters until the word has been spelled out.

- We implemented a class SecretWord to keep track of both the word being guessed and what the user sees / has guessed so far.

Play the game.

How does the game go?

```
word_list = [ ... candidate
              words for user
              to guess ... ]
N_CHANCES = 10
Set the secret word

User guesses
   until no more guesses
   or secret is solved

Reveal the word
```

Let’s solve the problem with a while-loop this time (instead of recursion)!

Setting up a `while`-loop

0. Situation is to do something until an event happens
1. Write the continuation condition
   - Create var names as necessary to express condition
   - May be easier to negate stop condition to get continuation condition
2. Initialize loop vars (vars in loop condition) as necessary
3. In loop body: update loop vars

   to possibly change loop condition from True to False
4. Write the rest of the loop body

Start next video:
Use while-loop get and check user input

Get and check user input with `while`-loop

- User may not enter appropriate input
- Can use `assert` and error out if user provides inappropriate input—not friendly
- Can *re-prompt* user for appropriate input
- Re-prompt how many times? Can *re-prompt until user does the right thing*

Indefinite iteration!
Use a `while`-loop.

Other changes to word guessing game?

- Allow 6 strikes instead of 10 guesses
  - Change in game module
- Accommodate space and hyphen

  E.g., “ice cream” displayed as ___ _____

  “high-rise” displayed as ____-____
  - Change in class SecretWord
- Change instance attribute display_word from a string to a list of letters. How about secret_word?

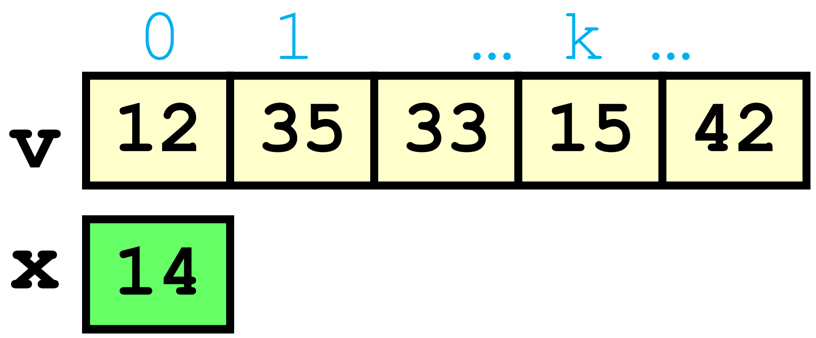
Great opportunity for extra practice! And fun ☺

Start next video:

Search algorithms (linear search, binary search)

Search Algorithms

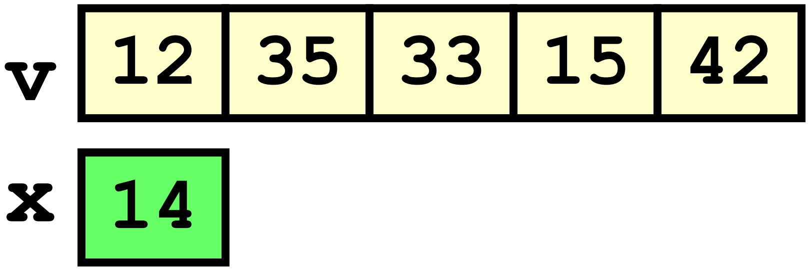
- Search for a target x in a list v
- Start at index 0, keep checking *until* you find it or *until no more element to check*



Linear search

Search Algorithms

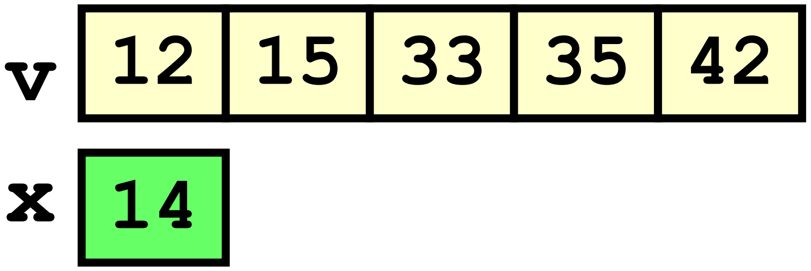
- Search for a target x in a list v
- Start at index 0, keep checking *until* you find it or *until no more elements to check*



Linear search

- Search for a target x in a *sorted* list v

Searching in a sorted list should require less work!

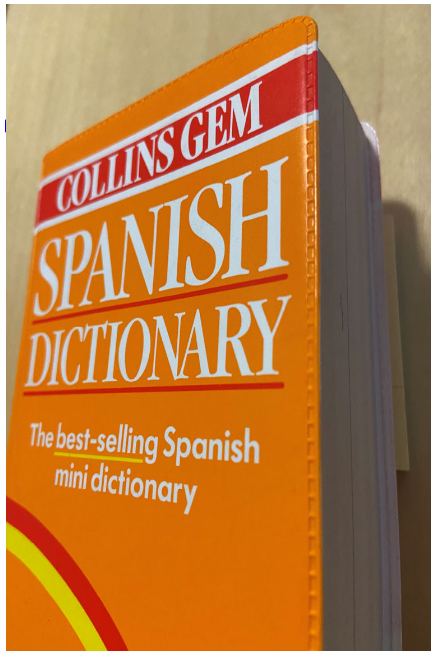


Binary search

How do you search for a word in a dictionary? (NOT linear search)

To find the word “**tanto**” in my Spanish dictionary…

```
while  dictionary is longer than 1 page:
    Open to the middle page
    if  first entry comes before “tanto”:
        Rip* and throw away the 1st half
    else:
        Rip* and throw away the 2nd half
```



* For dramatic effect only--don’t actually rip your dictionary! Just pretend that the part is gone.

Repeated halving of “search window”

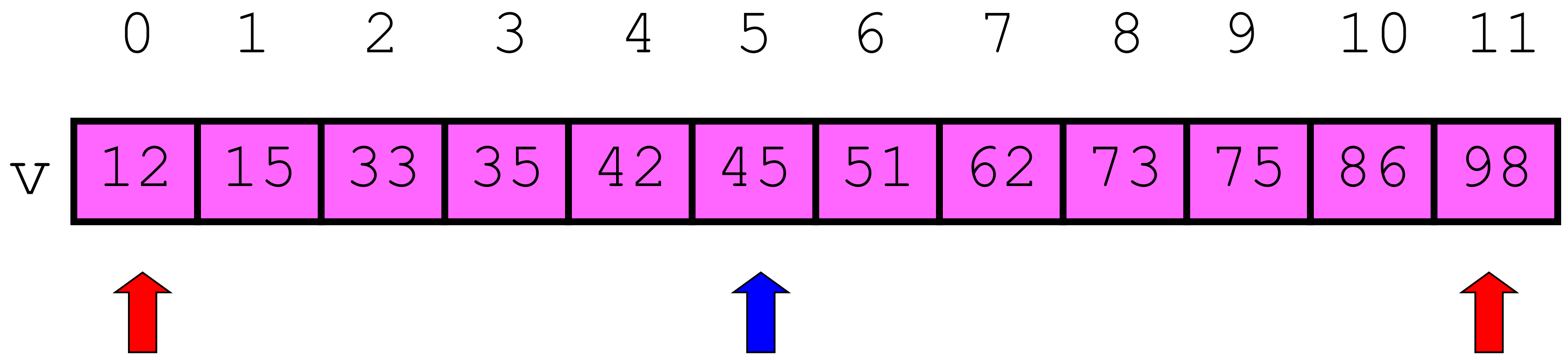
```
Original:             3000 pages
After 1 halving:      1500 pages
After 2 halvings:      750 pages
After 3 halvings:      375 pages
After 4 halvings:      188 pages
After 5 halvings:       94 pages
      :
After 12 halvings:       1 page
```

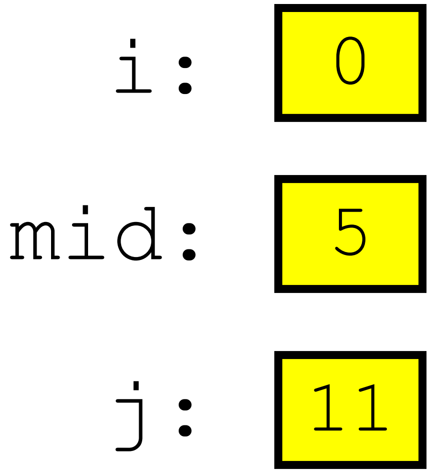
Binary Search

- Repeatedly halve the “search window”
- An item in a sorted list of length n can be located with just $\log_2 n$ comparisons.
- “Savings” is significant!

n	log2(n)
100	7
1000	10
10000	13

Binary Search: target x = 70

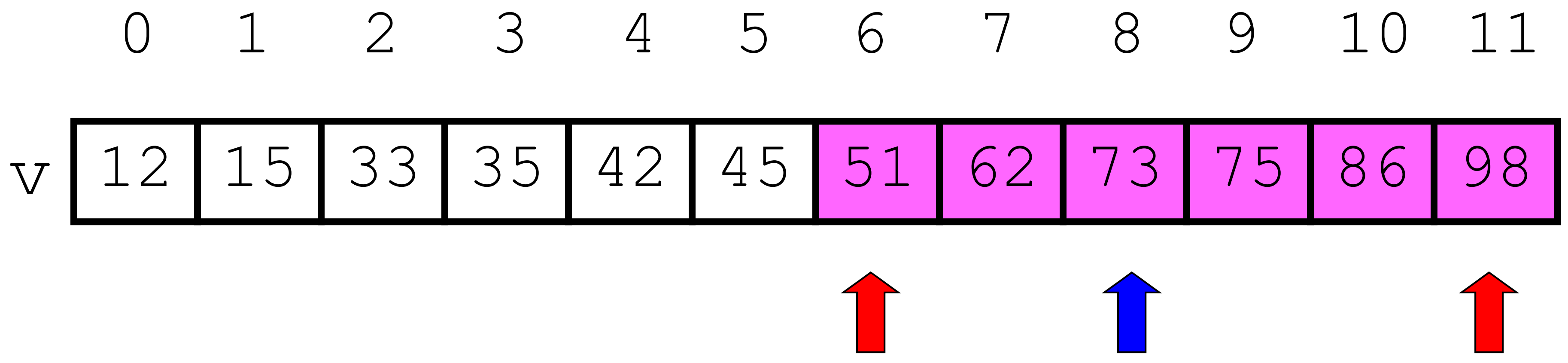




```
v[mid] is not x
v[mid] < x
```

So throw away the left half…

Binary Search: target x = 70



i: 6

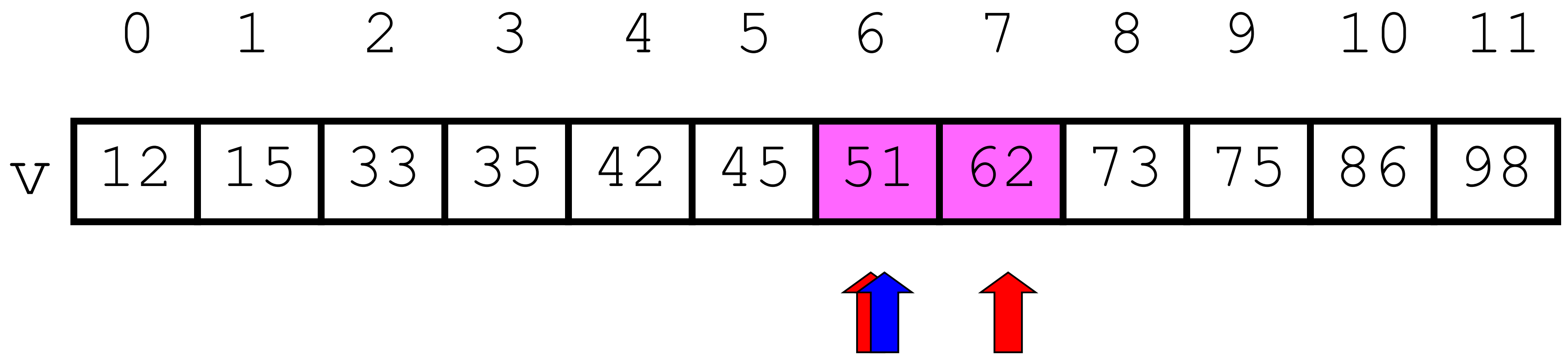
mid: 8

j: 11

```
v[mid] is not x
x < v[mid]
```

So throw away the right half…

Binary Search: target x = 70



i: 6

mid: 6

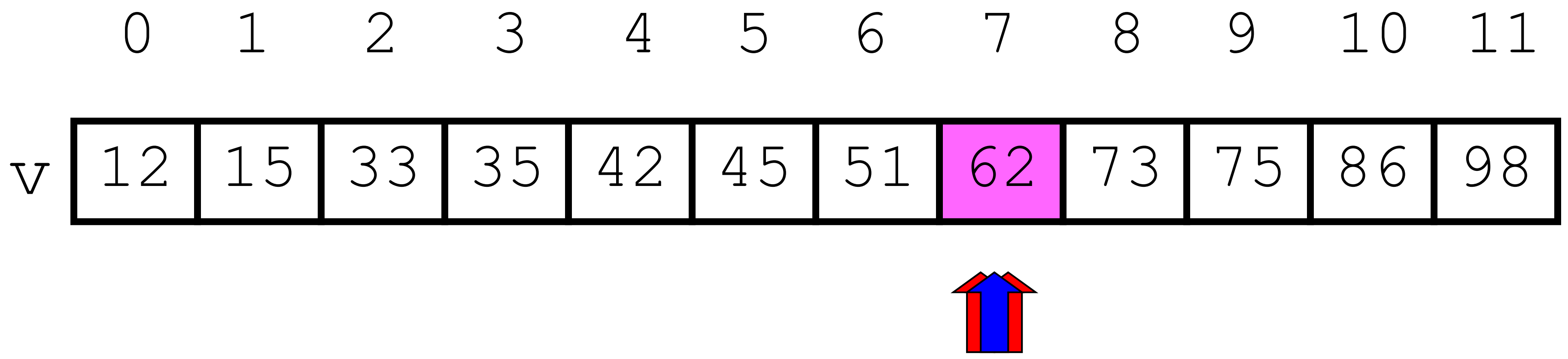
j: 7

v[mid] is not x

v[mid] < x

So throw away the left half…

Binary Search: target x = 70



	0	1	2	3	4	5	6	7	8	9	10	11
v	12	15	33	35	42	45	51	62	73	75	86	98

```
  i:  7
mid:  7
  j:  7
```

```
v[mid] is not x
  v[mid] < x
```

So throw away the left half…

Binary Search: target x = 70

	0	1	2	3	4	5	6	7	8	9	10	11
v	12	15	33	35	42	45	51	62	73	75	86	98

i:	8
mid:	7
j:	7

DONE because
i no longer less than j
→ no valid search window