

“Stand-alone topics” outline:

- ▶ Foldl, and how to model mathematical functions (last week Friday)
- ▶ Fixed-point iteration (this past Monday)
- ▶ The Huffman encoding (**Today**)
- ▶ Review for the final exam (Friday)
- ▶ **Final exam (Tues, Dec 12, 1:30pm)**

Today:

- ▶ The idea of an encoding
- ▶ Full binary trees and encodings
- ▶ Building an optimal encoding
- ▶ Implementation

Final version of modeling project due Fri, Dec 8

Encoding

ASCII/Unicode (last four bits):

A	0001	F	0110	K	1011
B	0010	G	0111	L	1100
C	0011	H	1000	M	1101
D	0100	I	1001	N	1110
E	0101	J	1010	O	1111

Sample encoding:

0001	1110	1110	1001	1011	0001
A	N	N	I	K	A

Message size: $4 \times 6 = 24$ bits.

Encoding

Variable-length codes (frequent letters are shorter):

A	0	F	100	K	01
B	10	G	101	L	0000
C	001	H	110	M	11
D	010	I	00	N	1
E	011	J	111	O	0001

Sample encoding:

0	1	1	00	01	0
A	N	N	I	K	A

Message size: $1 + 1 + 1 + 2 + 2 + 1 = 8$ bits.

Encoding

A	0	F	100	K	01
B	10	G	101	L	0000
C	001	H	110	M	11
D	010	I	00	N	1
E	011	J	111	O	0001

0	1	1	00	01	0
A	N	N	I	K	A

Or did you mean

011	0001	0
E	O	A

Encoding

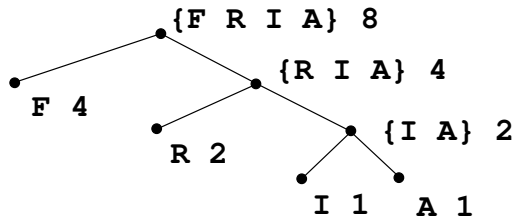
Prefix code

A	0	F	...	K	111
B	...	G	...	L	...
C	...	H	...	M	...
D	...	I	110	N	10
E	...	J	...	O	...

0	10	10	110	111	0
A	N	N	I	K	A

Message size: $1 + 2 + 2 + 3 + 3 + 1 = 12$ bits.

Trees



RIFFRAFF

A	111
F	0
I	110
R	10

Building the tree

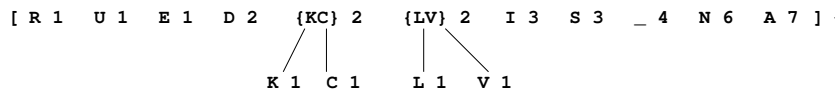
```
[ K 1   C 1   L 1   V 1   R 1   U 1   E 1   D 2   I 3   S 3   _ 4   N 6   A 7 ] .
```

Building the tree

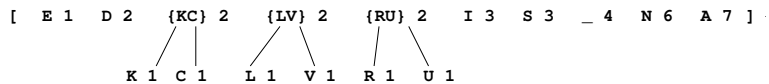
[L 1 V 1 R 1 U 1 E 1 D 2 {KC} 2 I 3 S 3 _ 4 N 6 A 7]

```
graph TD; Node["{KC} 2"] --> K["K 1"]; Node --> C["C 1"]
```

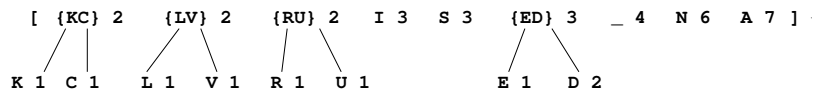

Building the tree



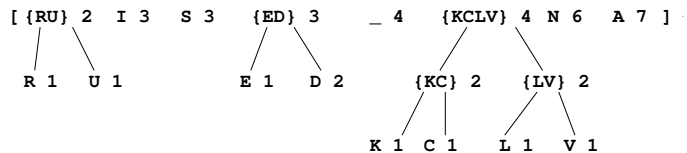
Building the tree



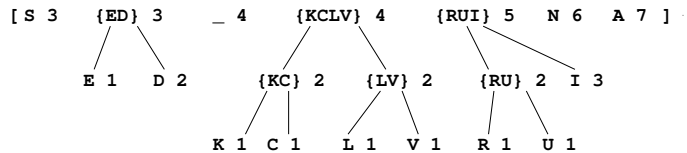
Building the tree



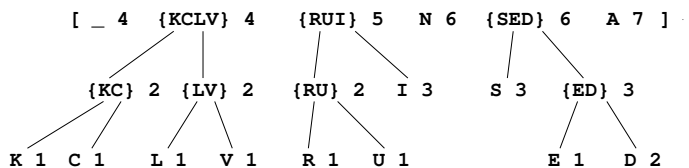
Building the tree



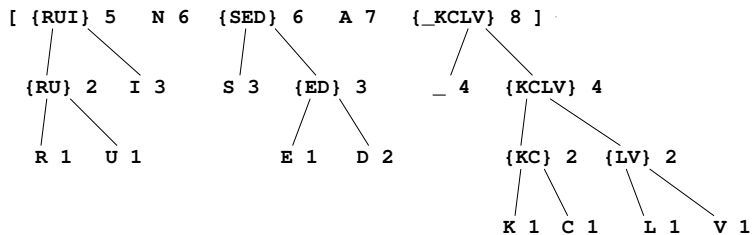
Building the tree



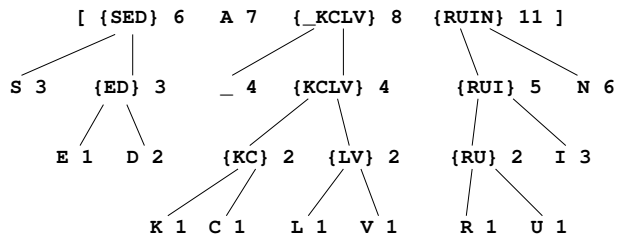
Building the tree



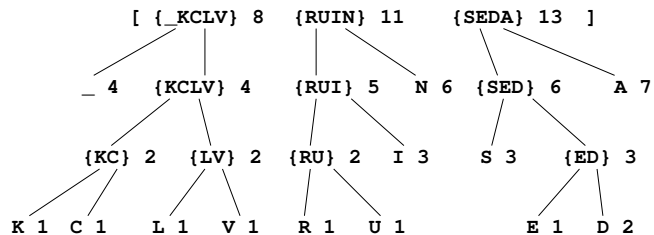
Building the tree



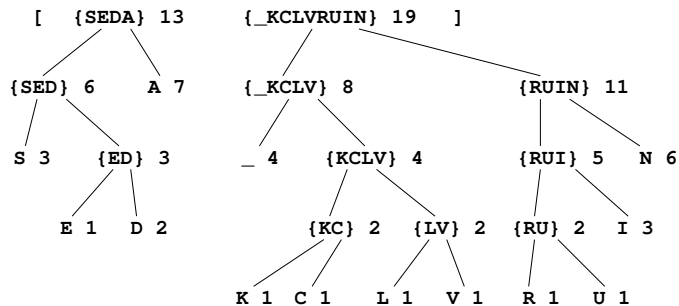
Building the tree



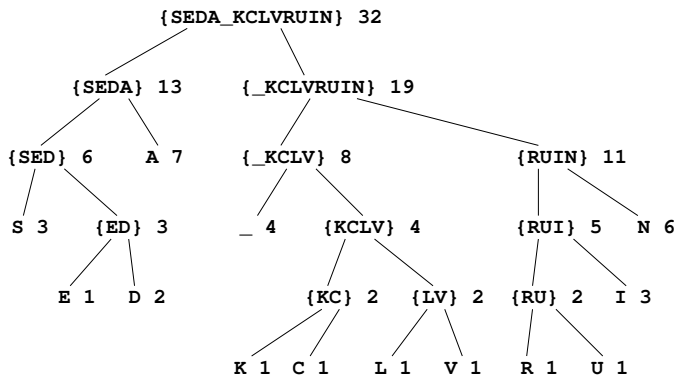
Building the tree



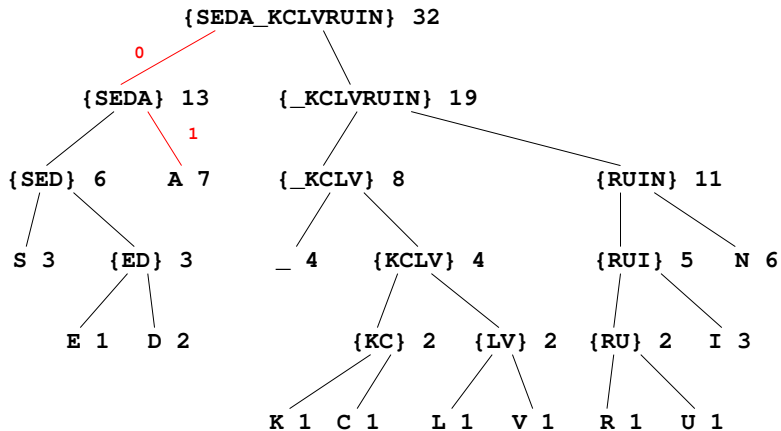
Building the tree



Building the tree

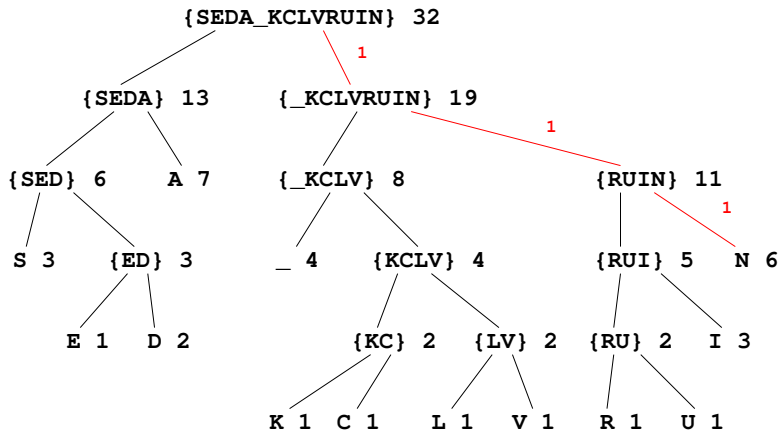


Encoding the message



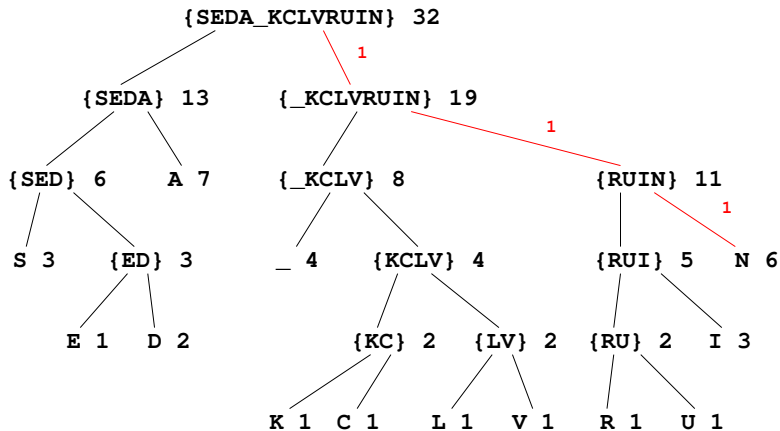
01
A

Encoding the message



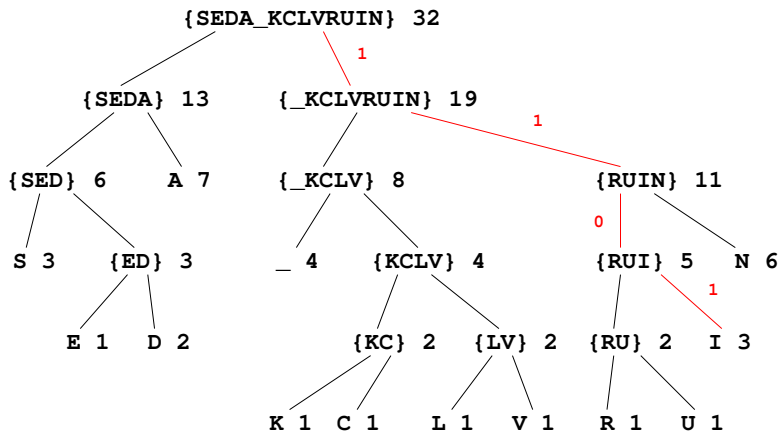
01	111
A	N

Encoding the message



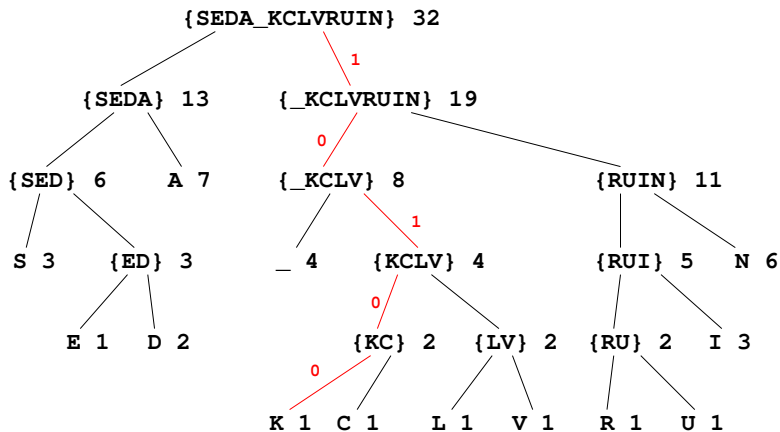
01	111	111
A	N	N

Encoding the message



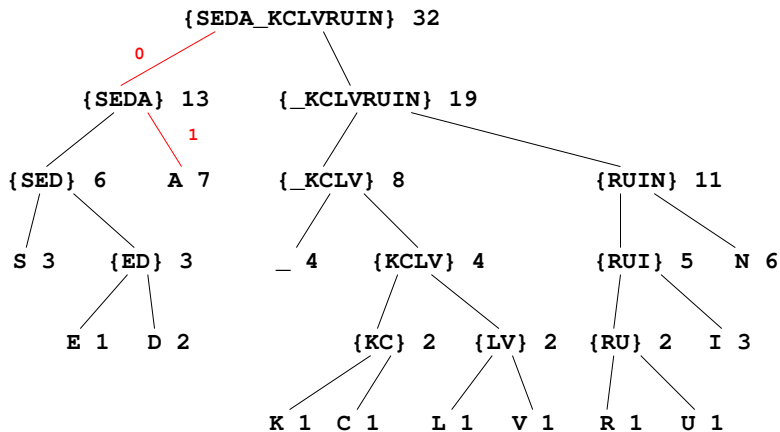
01	111	111	1101
A	N	N	I

Encoding the message



01	111	111	1101	10100
A	N	N	I	K

Encoding the message



01	111	111	1101	10100	01
A	N	N	I	K	A

For next time:

“Project” 6.(A–D).

See new versions of these problems on Schoology. There are a few changes from the book