# Linked List

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# Linked List for Sparse Vectors

# Application: Sparse Vector in Scientific Computing

Engineering

[3, 5, -1, 9, 2, -4, -5]

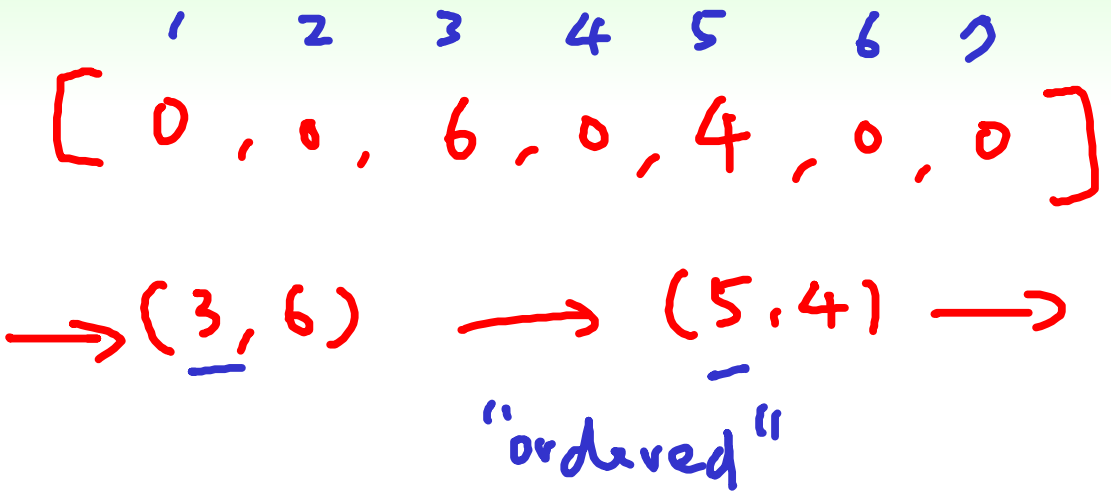
[0, 0, 6, 0, 4, 0, 0]

(3, 6) (5, 4)

$6 \cdot x^3$ $4 \cdot x^5$

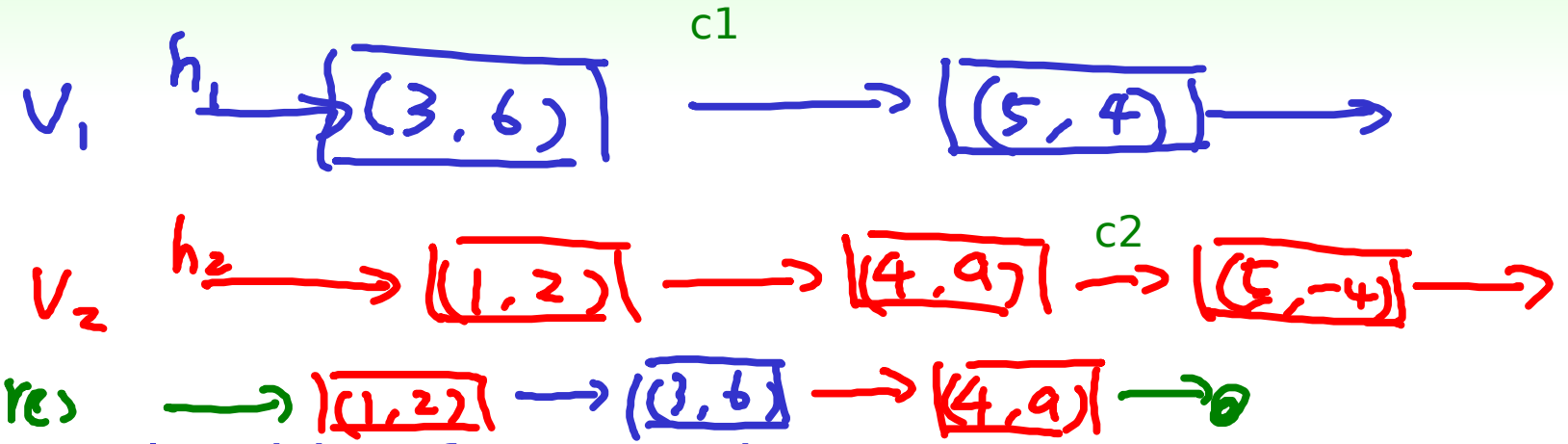
polynomial: can be viewed as special case of sparse vector

# Sparse Vector: (Dense) Array versus Linked List




storing only non-zeros can be time/space efficient

# Merging Sparse Vectors c1 = c1->next;




Q: algorithm for "merging" sparse vectors

```
while(!c1->end() && !c2->end()){
  if(c1->order < c2->order){
    res.insert_back(c1); c1++;
  }
  else if (c1->order > c2->order){
    res.insert_back(c2); c2++;
  }
  else{
    res.insert_back(c1 "+" c2); c1++; c2++;
  }
}
insert_back others
```

"running cursors" algorithm:
similar for other uses, like dot product

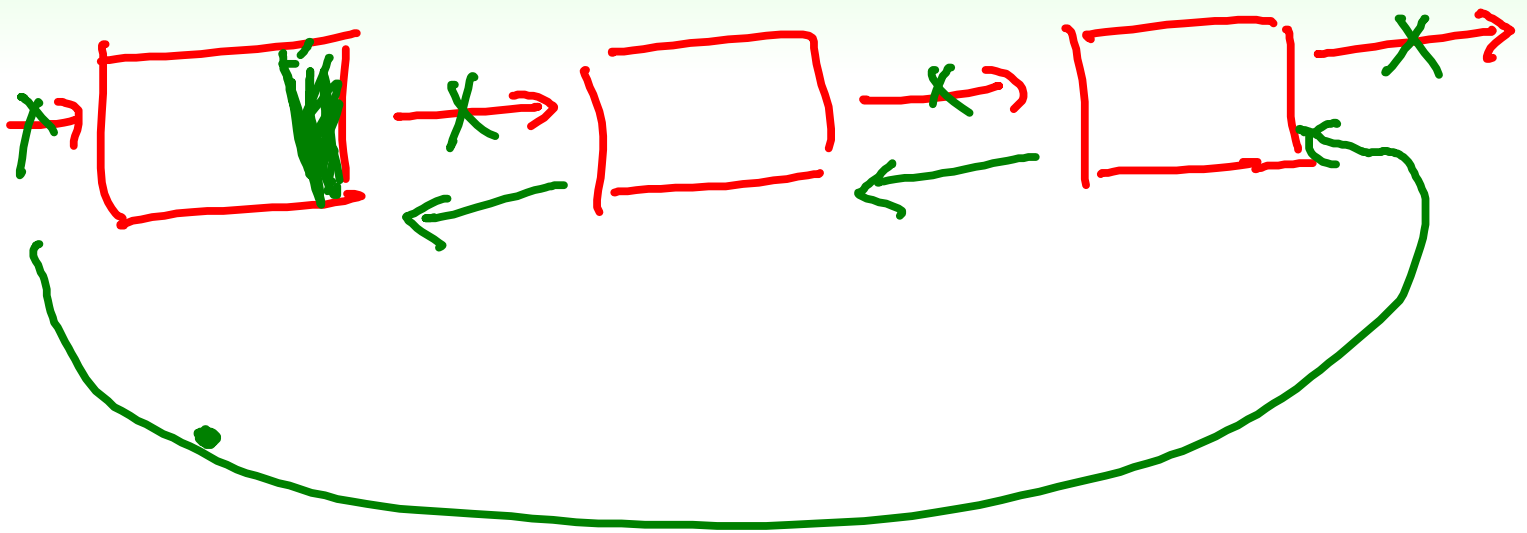
# Real-World Usage of Sparse Vector: LIBSVM

```
1  double Kernel::dot(const svm_node *px, const svm_node *py){
2          double sum = 0;
3          while(px->index != -1 && py->index != -1){
4                  if(px->index == py->index){
5                          sum += px->value * py->value;
6                          ++px;
7                          ++py;
8                  }
9                  else{
10                         if(px->index > py->index)
11                                 ++py;
12                         else
13                                 ++px;
14                 }
15         }
16         return sum;
17 }
```

good data structure needed everywhere

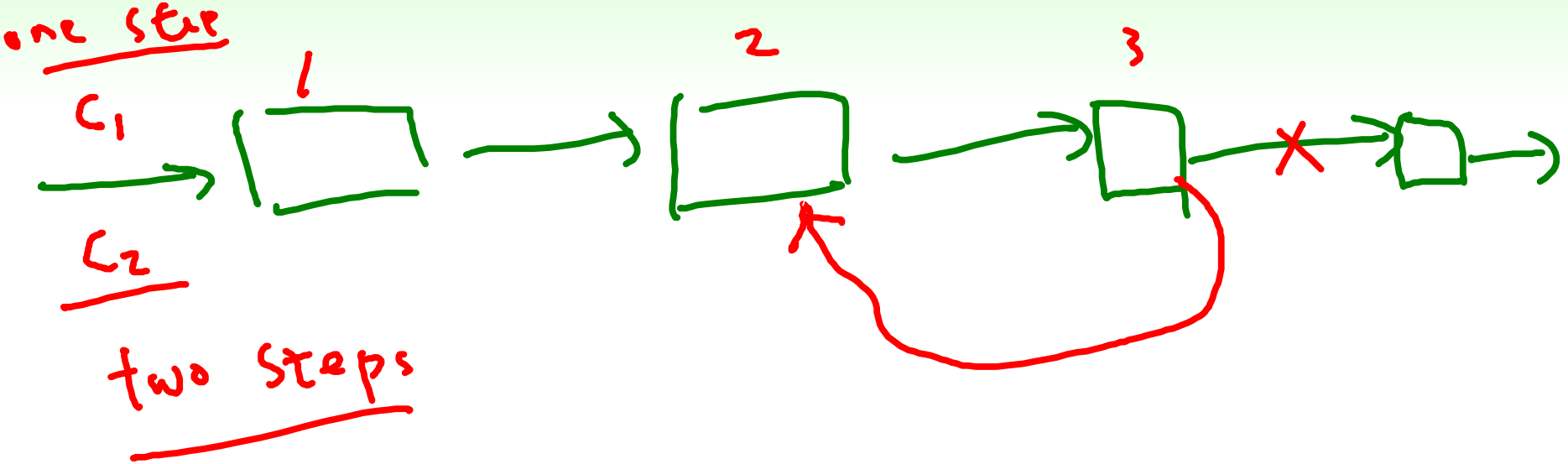
# Linked List in Job Interviews

# Linked List Reversal



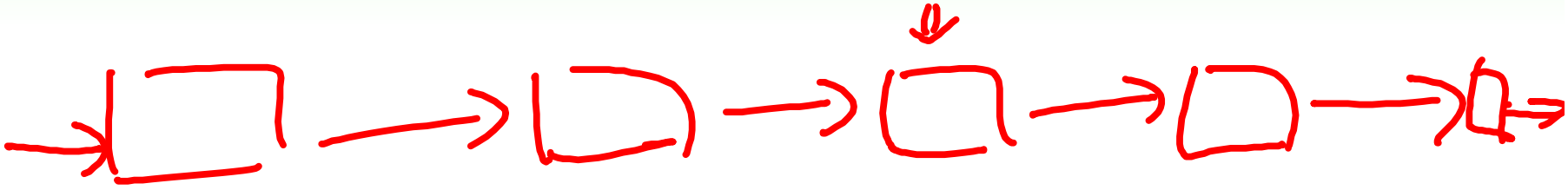
nothing special, but important to “code on board”

# "Cycle" in Linked List?




tortoise-hare (turtle-rabbit) algorithm

# Middle of Linked List



$N + \frac{N}{2}$

two pass, or tortoise-hare algorithm