Polynomial vs. Exponential

If you have an algorithm that takes exactly $f(n)$ microseconds, how large of an n can you handle in the given time?

	1 second	1 minute	1 hour	1 day	1 month	1 year	1 century
$\lg n$	2^{10^6}	$2^{6\cdot 10^7}$	$2^{36\cdot 10^8}$	$2^{864\cdot 10^8}$	$2^{25920\cdot 10^8}$	$2^{315360\cdot 10^8}$	$2^{31556736\cdot 10^8}$
$\sqrt{n}$	10^{12}	$36\cdot 10^{14}$	$1296\cdot 10^{16}$	$746496\cdot 10^{16}$	$6718464\cdot 10^{18}$	$994519296\cdot 10^{18}$	$995827586973696\cdot 10^{16}$
n	10^6	$6\cdot 10^7$	$36\cdot 10^8$	$864\cdot 10^8$	$2592\cdot 10^9$	$31536\cdot 10^9$	$31556736\cdot 10^8$
$n\lg n$	62746	2801417	133378058	2755147513	71870856404	797633893349	68654697441062
n^2	1000	7745	60000	293938	1609968	5615692	56175382
n^3	100	391	1532	4420	13736	31593	146677
2^n	19	25	31	36	41	44	51
$n!$	9	11	12	13	15	16	17

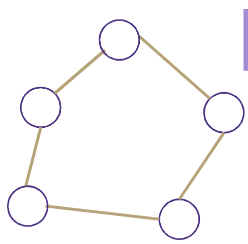
A new application

Bipartite (also called "2-colorable")

A graph is bipartite (also called 2-colorable) if the vertex set can be divided into two sets V_1, V_2 such that the only edges go between V_1 and V_2.

Called "2-colorable" because you can "color" V_1 red and V_2 blue, and no edge connects vertices of the same color.

If a graph contains an odd cycle, then it is not bipartite.



Try the example on the right, then proving the general theorem in the light purple box.

Help Robbie figure out how long to make the explanation Pollev.com/robbie

BFS With Layers

```
search(graph)
   toVisit.enqueue(first vertex)
   mark first vertex as seen
   toVisit.enqueue(end-of-layer-marker)
   l=1
   while(toVisit is not empty)
      current = toVisit.dequeue()
      if(current == end-of-layer-marker)
          l++
          toVisit.enqueue(end-of-layer-marker)
      current.layer = l
      for (v : current.neighbors())
         if (v is not seen)
            mark v as seen
            toVisit.enqueue(v)
```

It's just BFS!

With some extra bells and whistles.

Lemma 3

If a graph has no odd-length cycles, then it is bipartite.

Prove it by contrapositive

The contrapositive implication is "the same one" prove that instead!