Alex Harry
John Lambrecht
Justin Keeling

1.

n ϵ N
To show n log n (n^2) or that n log n ϵ n^2, we need the limit as n goes to infinity of (n log n) / n^2 to be finite.
The limit as n goes to infinity of (n log n) / n^2 = the limit from n to infitity of (log n) / n
Using L'Hopital's rule, the limit from n to infinty of (1 / n) / 1 = the limit from n to infinity of 1 /n = 0.
Therefore, n log n ϵ O (n^2) .

2.
If L_1 and L_2 are polynomial, run $L_1 \cup L_2$ on TM M.
Suppose $L_1 \epsilon$ O(n^i) and $L_2 \epsilon$O (n^j).
Run L_1 on TM M_1 and L_2 on TM M_2 .
O(n^i)➔ 1. If M_1 accepts, accept. If M_1 rejects, go to 2.
O(n^j)➔ 2 If M_2 accpets, accept. If M_2 rejects, reject.
Therefore, $L_1 \cup L_2 \epsilon$ O ($n^i + n^j$), which is polynomial.

3.
Claim: $3-CLIQUE=\{\langle G\rangle : G\,is\,an\,undirected\,graph\,with\,a\,3-clique\in it\}.\ 3-CLIQUE\in P$
Build a polynomial time decider
Suppose G=(V,E) where V are a set of vertices and E are a set of edges.
M = on input<G>
O($|V|^3$) $\rightarrow$ finding triples $a,b,c\in V$
O(|E|)➔ $If\,(a,b),(b,c),(a,c)\in E, accept.\ Otherwise, reject$
Therefor, M is a decider for 3-CLIQUE and runs in O($|V|^3|E|$)$\in P$

4.
$Claim: ISO=\{\langle G,H\rangle : G$ and $H\,are\,isomorphic\,graph$s$\}.\ ISO\in NP$
$L\,is\,an\,initially\,empty\,list\,of\,visited\,nodes$
$O(1)$➔1. $Let\,g\,be\,the\,first\,vertex\,on\,G$
$O(1)$➔2. $Let\,h$ in $H\,be\,the\,node\,equivalent$ to g
$O(1)$➔3. $If\,the\,degree\,of\,g\,is\,not\,equal$ to $the\,degree\,of\,h, reject.$
$O(n)$➔4. $Add\,g$ and H to L.
$O(n)$➔5. $For\,each\,child\,g^i\,of\,g\,not$ in $the\,list.$
$O(1)$➔ 1. $Let\,h^i$ in $H\,be\,the\,isomorphic\,vertex.$
$O(1)$➔ 2. $If\,h^i\,is\,not\,it\,H, reject.$
$O(n)$➔ 3. $Otherwise, execute\,step$ 1 in $context\,of\,g$
$O(1)$➔6. $If\,each\,child\,of\,g$ is $isomorphic$ ¿ $some\,child\,of\,h, then\,g$ and $h\,are\,isomorphic$

$Because\,we\,are\,able$ to $verify$ in $polynomial\,time, ISO\in NP.$