David Toledo, Angel Ortiz

Id_rsa_homwork

-----BEGIN RSA PRIVATE KEY-----
MIIG4wIBAAKCAYEA8YwM+2qkOEbIo1Js5xpIUQ5DIStrsKgWgtEPBcTPzbqsHVOD
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r3VGw3kjcM9Z3rR0M5/iHVh0uSRYzO1kOwvIBUz945NYHTyyZnbUYdq8gb2VYQv3
uxI2YEOSE9Y0TtPKIScEqfG/Ea1BBFzaAr6LPMPuTaSmVA4b887D+sX9aMeyf3yi
iGIrh0xiBK2JxHmtL/uf3f6C/DGYDFfgIQAxz4SVSs9xfwIZEIqFYvQIcvuXKZuA
GzvX0EE9TDRBfIFGIYiJQ5q3Dq3rnVt79MhJhRbf5xCv4z0iMasdb84yxGYaNVgU
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Nzo9VeV0+5y/L73nAgMBAAECggGALH1WOsymmLL+QvnAk0R1A3D0I7qOqEgddVTa
Rn68o7D5WKF0Q+cCgIX6B2NER9cG7xiI5aJAMPQUQMapoF+2rpvbI+YkPiLocifE
V4nZeQ2Z2keugMzCDuj2DSYz8GAecw/EzxDm1t8J+BzVdEa0Pb2zmcIe3au7VEIY
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cTAcf7sgdnjXWvbH1nDMMP5hvK2ITAxJSIa9heI33IaDsnx+fALAsbYWDqK7ijJL
6RbthWMZMMJIVYmdEH2hQ9/GTI2pnXn0ohTY+rVURGT0eyof9nxy8NILNp8eWdGk
syfnd3gv27V4EeNIZ4nYECdgC/MC4wKbhsnc53mrL/cIj1oLFaaf60JIDXukITfr
aL8VWW6xvHijp+QBzDi2ups0Qw6xgVKYCqc5SBhqWtm4tAtMs2SFEKk+Xyd0qhNU
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EXc2C/8abX5QNzn88VRBSV08Tq/0hQmK5j/9CeO4XL2uFMadnupshbj/reemeYze
nDmKVeKcZ45fI0I4pNUDcfTzKBNnrBgUa1IUiCNO9seyzFPWKiwymaAN6vQt945v
TI/5zXM6h6zUKvHnsUpZED0GMsMcAfskFavetJF9DyygDZWP1PgK2m5z/X6np11/
uDG/iT0t3Ga3vZZZQIC+wdJB6LxsDwn79wKBwQD1M1nEXu1DoqqC2m2INtPsS0my
H1eDBxtqaQIyYZsFhDvoKIYy0mBBofXPcaJnIQwCP+Ok/Yo7/z70PLBIOKRVQRfM
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X5nwzrAZog9BXZcxCcyhrWoAfVqpQpYXBGiOIOK3bT+IGTbKYsS3Or69IF0kqn1L
Ow8mZQY0C6iGitp/Zn7p1FLCR++TckSAS3vEh8iJYCM9x1XgsuTf/Ks0bqhUE+MN
2/JiBKfKchBXtDCiq4XM/eufP5zoLZ7Chmv8kfwfJncCgcEA10EeM/rVtYOOxtL0
YI6SWqT5bEqBa8CIe9D7/xLaoWwInznTdEgIQIjpTxRF6t0jCrKFqOj/Oo5n+Mdy
X1nrQgCj4RA/sRUyrHW7mmntrKNXTHw4OEXqGZyJB1VvuMPN/GIV8tXzSJxysqMA
NVvLYkcK0uRsLI3kKKkrmcFC0z3ykIkVA9X557AITqQ+M7C9I/qghf+4IcxXScmd
JG0EJmpq7E0xLn7tofYk7/95Lf2sVfU6GYOWKsjI9xSL0NdRAoHAT+rgNIfr5yIK
yq0To8SswEuI2YfxoLSJZ0lInUwPyooAVzirpyUCWXYVqVzXAUPRsxBapCT5RAJM
hqETfQUSgbwIO6okSK5Hu6IRDfIMkEqV8NkHPfb1bwOkDZPjUP2aDV953DNR6o1w
wdF6osEwkQwbLVnQbZEfM8uUgbhJ6t8bIoYuOZ1RabLUkLZE3S98qpdNm5XGwpfm
S3x5R3tE7eEgIPUVENuRiBCg9NVUvbihIs06kEXmxNxc8UjIBCP/
-----END RSA PRIVATE KEY-----

Id_rsa_homwork,pub

ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABgQDxjAz7aqQ4RuWjUmznGkhRDkOVK2uwqB
aC0Q8FxM/NuqwdU4OqeXy2pvW+PZ98Pfxa2HfqSUpmx2v8wN9s7kV72BTdA1UnygR
kML8GjqpcUcEYUMavdUbDeSNwz1netHQzn+IdWHS5JFjM7WQ7C8gFTP3jk1gdPLJm
dtRh2ryBvZVhC/e7GXZgQ5IT1jRO08qVJwSp8b8RrUEEXNoCvos8w+5NpKZUDhvzzs
P6xf1ox7J/fKKIaWuHTGIErYnEea0v+5/d/oL8MZgMV+AhADHPhJVKz3F/AhkSWoVi9C
Vy+5cpm4AbO9fQQT1MNEF8gUaVilDmrcOreudW3v0yEmFFt/nEK/jPSIxqx1vzjLEZho
1WBSrS7mLH6bdzWkZN3+f1LIOC3ttFWTdG3kVzi/DGsxfnY8pUKmUs0APEkPePUi6Y
kbkYR93V23zMPM/3crbuOrovcUjPJgtIZ9uihvOSb7K7iLi3m2b6J5kJe4ZtJxwwWw3Oj1
V5XT7nL8vvec= angel@Angels-MacBook-Pro-2.local

Id_rsa_homwork,pub.pem

-----BEGIN RSA PUBLIC KEY-----
MIIBigKCAYEA8YwM+2qkOEbIo1Js5xpIUQ5DIStrsKgWgtEPBcTPzbqsHVODqnl8
tqb1vj2ffD38Wth36kIKZsdr/MDfbO5Fe9gU3QNVJ8oEZDC/Bo6qXFHBGFDGr3VG
w3kjcM9Z3rR0M5/iHVh0uSRYzO1kOwvIBUz945NYHTyyZnbUYdq8gb2VYQv3uxl2
YEOSE9Y0TtPKIScEqfG/Ea1BBFzaAr6LPMPuTaSmVA4b887D+sX9aMeyf3yiiGIr
h0xiBK2JxHmtL/uf3f6C/DGYDFfgIQAxz4SVSs9xfwIZEIqFYvQIcvuXKZuAGzvX
0EE9TDRBfIFGIYiJQ5q3Dq3rnVt79MhJhRbf5xCv4z0iMasdb84yxGYaNVgUq0u5
ix+m3c1pGTd/n9SyDgt7bRVk3Rt5Fc4vwxrMX52PKVCpILNADxJD3j1IumJG5GEf
d1dt8zDzP93K27jq6L3FIzyYLSGfboobzkm+yu4i4t5tm+ieZCXuGbSccMFsNzo9
VeV0+5y/L73nAgMBAAE=
-----END RSA PUBLIC KEY-----

Private Key:

In a private key, we should expect to see a version, a modulus number, a public exponent, a private exponent, 2 different prime numbers, 2 different exponents derived from taking the -d mod (p-1) and -d mod (q-1) a coefficient number and other optional “PrimeInfos”.

Decoding:

I went to the website and pasted the key into the decoder

Version INTEGER:

Our version was 0. This tells us that our key used 2 prime integers instead of multi-prime integers.

Modulus INTEGER:
Modulus is the RSA modulus n.
548161454685121424703432386096538644940814449999794752680136541495816
915620386152681552127600981793375711918645759995921803308124422804755
2290922187107164086169712779307420648350090579659740976551441000779O3
4370548416736671827659398307846429497530573734890624715240569041120 83
380480550978908952720821632334964101044733482762547688571840801637283
0677908294902910149393245382715996077800341976252335185753520753932O3
965293358451595098902658082269357678855516967760347841833216272279956
870048419957246078019794494332514568089716152646137006976773240695275
257614178263938986363547029552790630512024871185063088647049266964280
708282976208458617326136357066239380878256555063624499157509324497141
725565979133166420394181875409576748645061110828451710690535613064793
115814909979743388843727425468929114816462001915095312711273932134103
872143485962540543809191960625213139461318117313292345634266311214674
370853224760844082319194467 9 (3072 bit)

publicExponent INTEGER: is the RSA public exponent e:
Our number was: 65537

privateExponent INTEGER is the RSA private exponent d.
(3070 bit)
100963683407908520646278168554729663901011203227909767911285658366968
368836743843157590608851052859115281727420738955258435505628422229827
431380322139509861122960469595831171164737390156816353095125569251573
498766940718110938296956828927192655240080497358537514591252130697727
367529498311891144976014128262132103448601215655686301612076999505068
036548867094577152468568694042700747143030544570764511691457877261262
570228361534235690355890347606289829279108676287127972161359573193358
113387520701692791140096158477461319132702296788878753571529183782130
683043611318968018554138012445999323879683728220967408829243036925685
997554271233558119831965619818609434111166701202139930031224196104834
665278273860118050749930296925222340719779219131751893496952464371387
190962200373882266714777297006838589844947790666892364863222529046757
366803624721471648995638828085400929947237059019477709091136287687052
821830740445287767216015734 5

Prime1 INTEGER: the first prime factor (p) of n:

(1536 bit)
237439851001436079821640738294976777162479692191708917636998678981020
193900343829106044824239640367092203120110313868299249844343173351005
212573416785448110131629175203346043476279438461855844570833054751141
833139983390494539440465239965016017584440981722062719084111538107104
568377617885221077157021944628571196254341991294460326110560181071161
059195048430666273789328162888937961020039307329551139743192486686567
7568167650543024670230034554127942000938882563063

Prime2 INTEGER: the first prime factor (q) of n:
(1536 bit)
230863291218038223736366160597664849625261874986068433111026426913598
211611908620705147551624830811005121084380766677807806572839149548808
999626949085713394892743947945687061110773519962474730284873838031518
125996366038294780619870354824160181170308416633374337032957665934364
457946268758944923796947644639299101180257153270107502791956691554816
986584397909549835350783877113189678731770283779758281767907297577961
2168625859050013624818881234157639412794560377233

Exponent1 INTEGER: d mod (p - 1):
114779924616270144267046099606682626261264921011421490450550912443317
526938321754885158095072036353050156202575870937967690530824359902546
594130619606936258557458289204834002218166972701070464193487068489111
866818862837698666463423398497515486718840879837903306579546479679740
907132937305975081944727592471089065238473055315314976143379420732036
155398604289667488898175161030935861316139971245365360913744620149185
2404551922377490037346197181886984917401540175479

Exponent2 INTEGER: d mod (q - 1).
(1536 bit)
202668076562054917469892645645443822474177814876687598794218280049743
593827424793247009385349213284855236451892498119753979211058711735227
858698708542477512677788692756141014799062101164243994346394350114703
638295145143677824944733526467467349791283612831956386964877144120142
672978968834526729951169398035198364102777588218702335446078464611185
829213423942660339613297050550881819223872617554981662647863200200693
3898371172753168956111886324439499341384400295761

Coefficient is the CRT coefficient q^(-1) mod p.
(1535 bit)
7524457181599526340102426827423156560470031211840411763044195027688076364987275789292673229866744372948379432716814662416476276768725819563668152603935541003932863220966257867403098131425646502690794500668326647782222229926736122608829461479173672437414992711892595521457659774575425001567727204811387670355421558734531916185119407513955331128188084311272102480205610214870423258485361308634297100213465580007819502853872288069714030170983406629846718583608535O3

p*q should be n
Relationship between e and d and n

Public Key:
What I expect:
Before Conversion: Algorithm Key(Modulus and publicExponent) Comment

After Conversion: Modulus and publicExponent

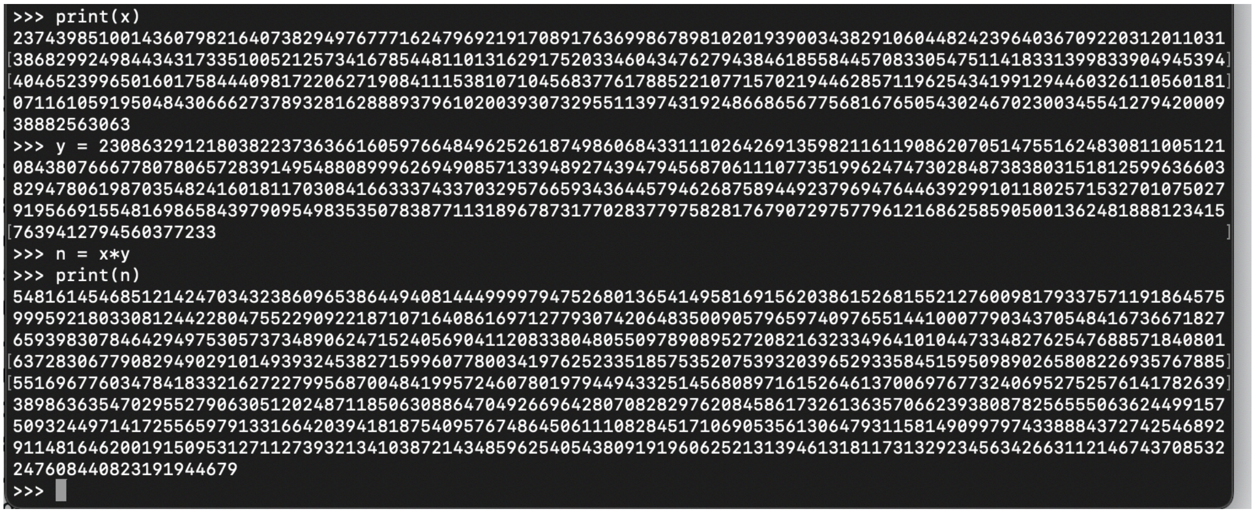
Decoding:
I changed our pub file to a pem file and then used the decoder to view the file.

Modulus is the RSA modulus n.
Modulus INTEGER:
548161454685121424703432386096538644940814449999794752680136541495816915620386152681552127600981793375711918645759995921803308124422804755229092218710716408616971277930742064835009057965974097655144100077903437054841673667182765939830784642949753057373489062471524056904112083380480550978908952720821632334964101044733482762547688571840801637283067790829490291014939324538271599607780034197625233518575352075393203965293358451595098902658082269357678855516967760347841833216272279956870048419957246078019794494332514568089716152646137006976773240695275257614178263938986363547029552790630512024871185063088647049266964280708282976208458617326136357066239380878256555063624499157509324497141725565979133166420394181875409576748645061110828451710690535613064793115814909979743388843727425468929114816462001915095312711273932134103872143485962540543809191960625213139461318117313292345634266311214674370853224760844082319194467

publicExponent INTEGER: is the RSA public exponent e:
publicExponent INTEGER: 65537

Sanity Check:

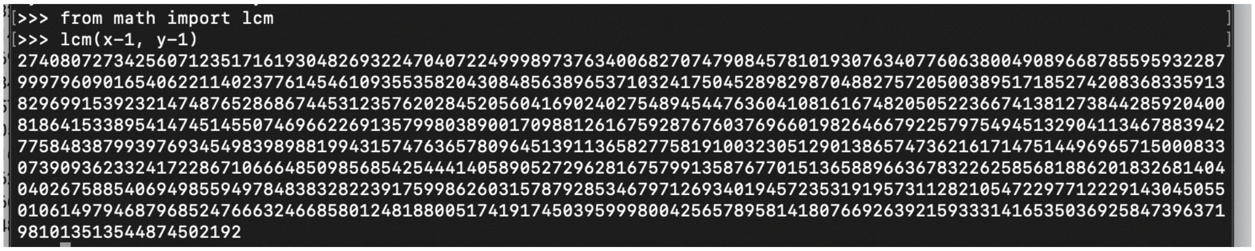
p * q = n



```
>>> print(x)
23743985100143607982164073829497677716247969219170891763699867898102019390034382910604482423964036709220312011031
[38682992498443431733510052125734167854481101316291752033460434762794384618558445708330547511418331399833904945394]
[40465239965016017584440981722062719084111538107104568377617885221077157021944628571196254341991294460326110560181]
07116105919504843066627378932816288893796102003930732955113974319248668656775681676505430246702300345541279420009
38882563063
>>> y = 230863291218038223736366160597664849625261874986068433111026426913598211611908620705147551624830811005121
08438076667780780657283914954880899962694908571339489274394794568706111077351996247473028487383803151812599636603
82947806198703548241601811703084166333743370329576659343644579462687589449237969476446392991011802571532701075027
91956691554816986584397909549835350783877113189678731770283779758281767907297577961216862585905001362481888123415
[7639412794560377233                                                                                              ]
>>> n = x*y
>>> print(n)
54816145468512142470343238609653864494081444999979475268013654149581691562038615268155212760098179337571191864575
99959218033081244228047552290922187107164086169712779307420648350090579659740976551441000779034370548416736671827
65939830784642949753057373489062471524056904112083380480550978908952720821632334964101044733482762547688571840801
[63728306779082949029101493932453827159960778003419762523351857535207539320396529335845159509890265808226935767885]
[55169677603478418332162722799568700484199572460780197944943325145680897161526461370069767732406952752576141782639]
38986363547029552790630512024871185063088647049266964280708282976208458617326136357066239380878256555063624499157
50932449714172556597913316642039418187540957674864506111082845171069053561306479311581490997974338884372742546892
91148164620019150953127112739321341038721434859625405438091919606252131394613181173132923456342663112146743708532
247608440823191944679
>>>
```

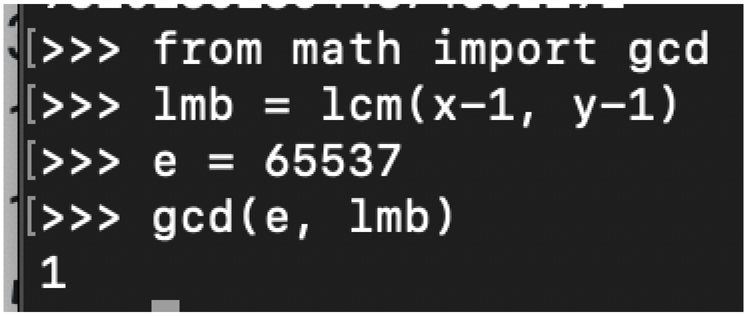
lcm(p_B - 1, q_B - 1) = λ(n_b) =

27408072734256071235171619304826932247040722499989737634006827074790845781019307634077606380049089 66878559593228799979609016540622114023776145461093553582043084856389653710324175045289829870488275 72050038951718527420836833591382969915392321474876528686744531235762028452056041690240275489454476 36041081616748205052236674138127384428592040081864153389541474514550746966226913579980389001709881 26167592876760376966019826466792257975494513290411346788394277584838799397693454983989881994315747 63657809645139113658277581910032305129013865747362161714751449696571500083307390936233241722867106 66485098568542544414058905272962816757991358767701513658896636783226258568188620183268140404026758 85406949855949784838328223917599862603157879285346797126934019457235319195731128210547229771222914 30450550106149794687968524766632466858012481880051741917450395999800425657895814180766926392159333 1416535036925847396371981013513544874502192



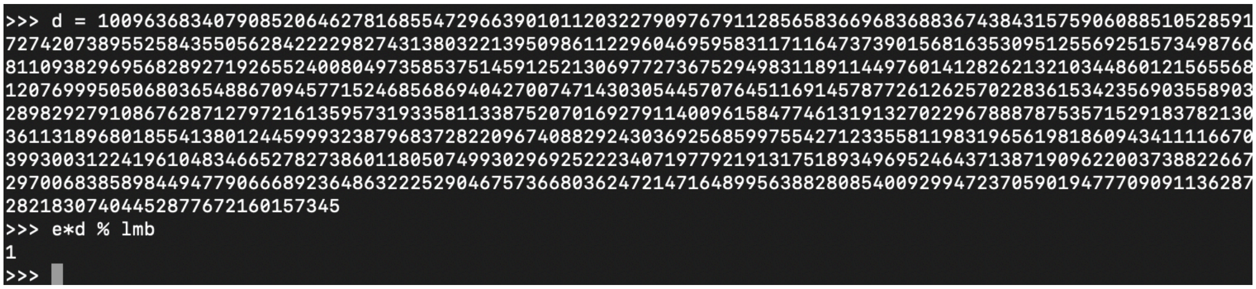
```
[>>> from math import lcm                                                                                        ]
[>>> lcm(x-1, y-1)                                                                                               ]
 27408072734256071235171619304826932247040722499989737634006827074790845781019307634077606380049089668785595932287
 99979609016540622114023776145461093553582043084856389653710324175045289829870488275720500389517185274208368335913
 82969915392321474876528686744531235762028452056041690240275489454476360410816167482050522366741381273844285920400
 81864153389541474514550746966226913579980389001709881261675928767603769660198264667922579754945132904113467883942
 77584838799397693454983989881994315747636578096451391136582775819100323051290138657473621617147514496965715000833
 07390936233241722867106664850985685425444140589052729628167579913587677015136588966367832262585681886201832681404
 04026758854069498559497848383282239175998626031578792853467971269340194572353191957311282105472297712229143045055
 01061497946879685247666324668580124818800517419174503959998004256578958141807669263921593331416535036925847396371
 981013513544874502192
```

gcd(e, λ(n_B)) = 1.



```
[>>> from math import gcd
[>>> lmb = lcm(x-1, y-1)
[>>> e = 65537
[>>> gcd(e, lmb)
1
```

$e_B d_B \bmod \lambda(n_B) = 1$



```
>>> d = 1009636834079085206462781685547296639010112032279097679112856583669683688367438431575906088510528591
7274207389552584355056284222298274313803221395098611229604695958311711647373901568163530951255692515734987 66
8110938296956828927192655240080497358537514591252130697727367529498311891144976014128262132103448601215655 68
1207699950506803654886709457715246856869404270074714303054457076451169145787726126257022836153423569035589 03
2898292791086762871279721613595731933581133875207016927911400961584774613191327022967888787535715291837821 30
3611318968018554138012445999323879683728220967408829243036925685997554271233558119831965619818609434111166 70
3993003122419610483466527827386011805074993029692522234071977921913175189349695246437138719096220037388226 67
2970068385898449477906668923648632225290467573668036247214716489956388280854009299472370590194777090911362 87
28218307404452877672160157345
>>> e*d % lmb
1
>>> 
```

Public key numbers correspond to what we have in our private key, so they check out.