RSA Assignment

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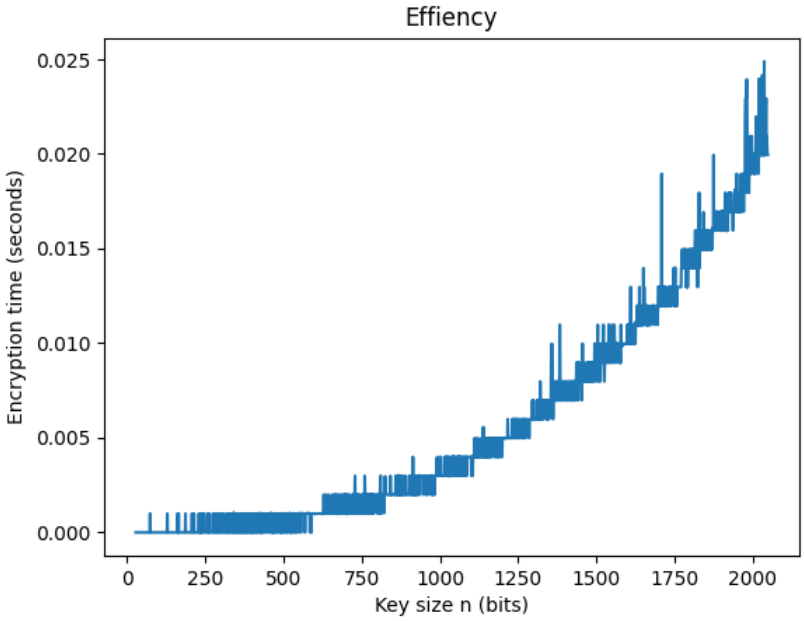
Section: 2

BN: 34

Efficiency Analysis:

Figure1: from 28 to 2048 bits



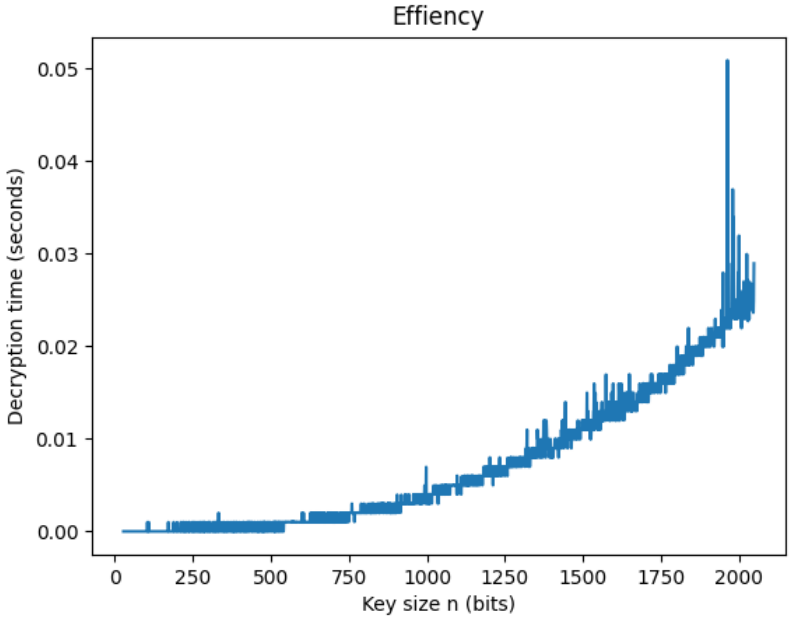
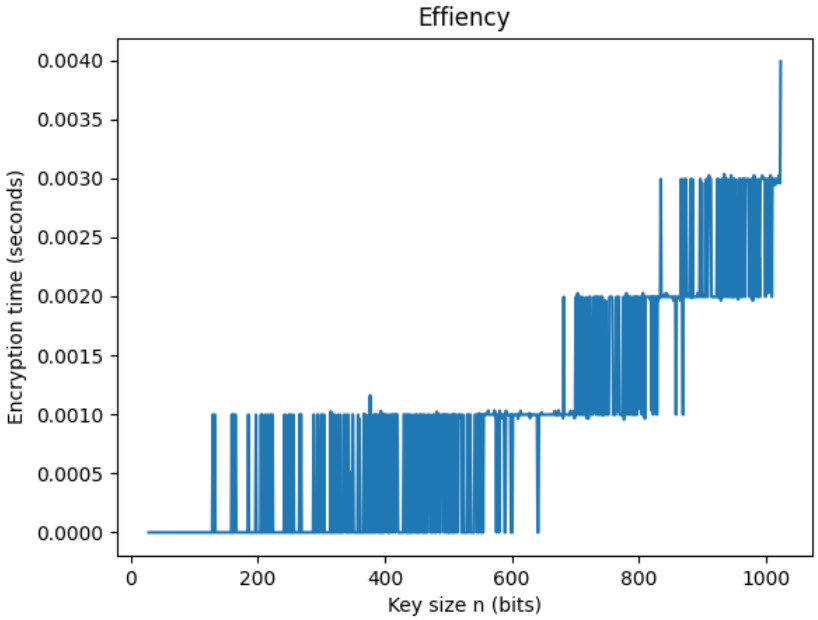


Figure2: from 28 to 1024 bits



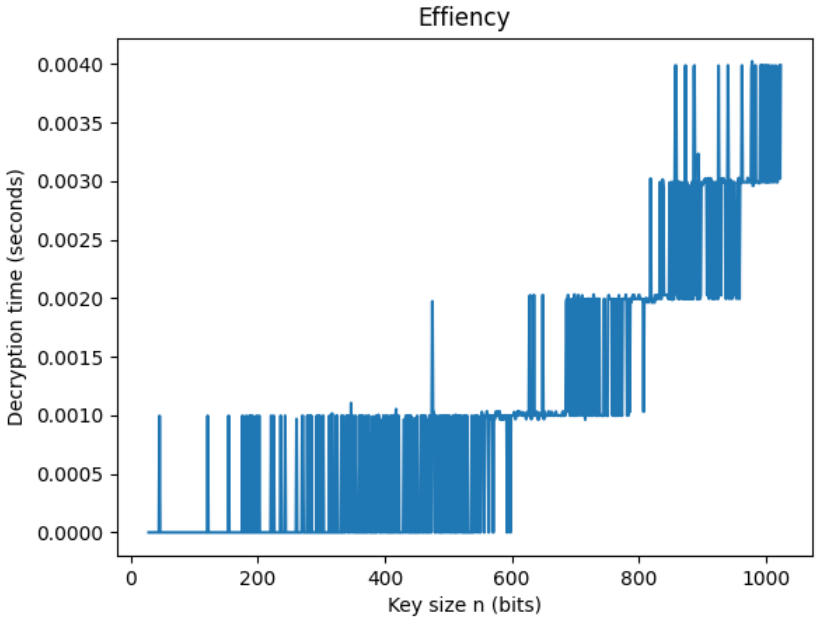
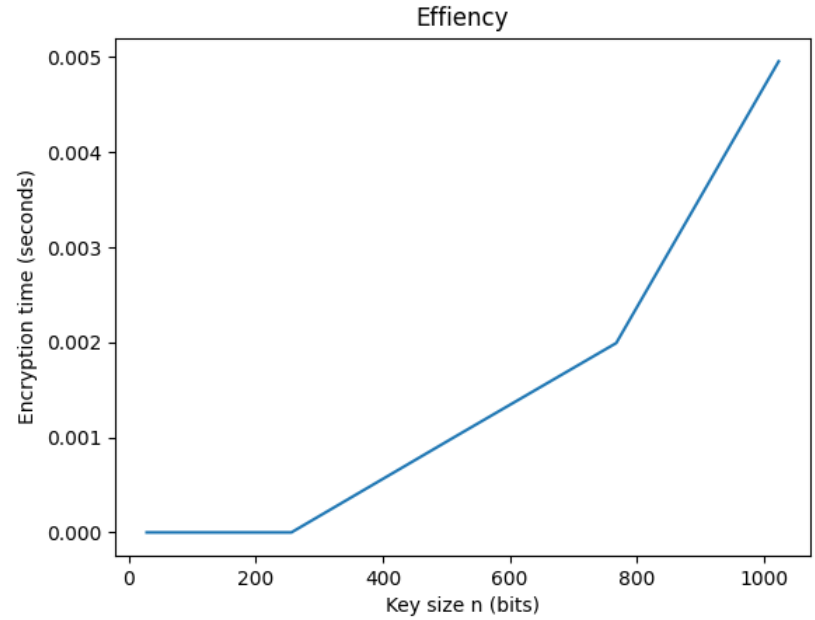
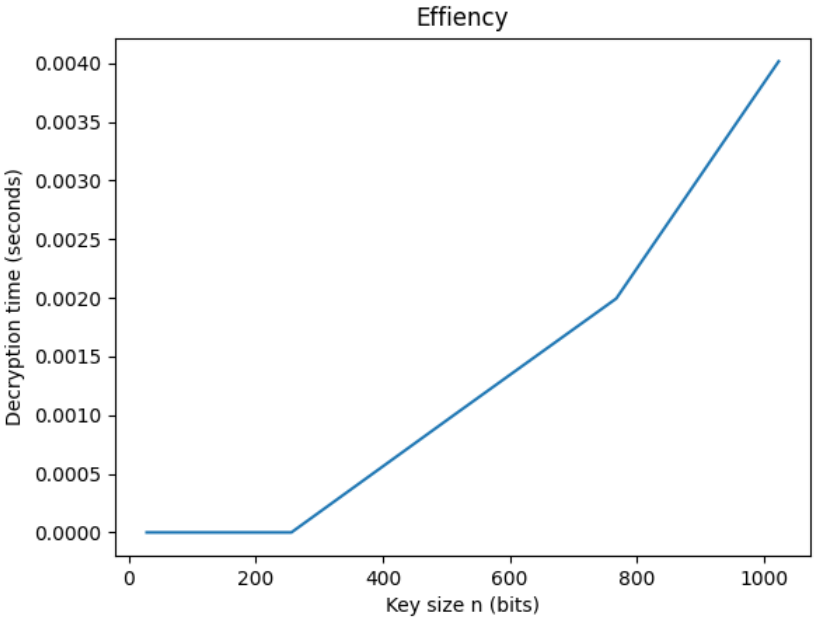


Figure3: from 28 to 1024 bits with only these samples (28,32,64,128,256,512,786,1024)





Size of n (bits)	Time of encryption (seconds)
28	0.0
32	0.0
64	0.0
128	0.0
256	0.0
512	0.00099945068359375
786	0.0019922256469726562
1024	0.004956245422363281

Size of n (bits)	Time of decryption (seconds)
28	0.0
32	0.0
64	0.0
128	0.0
256	0.0
512	0.0009999275207519531
786	0.0019943714141845703
1024	0.0040171146392822266

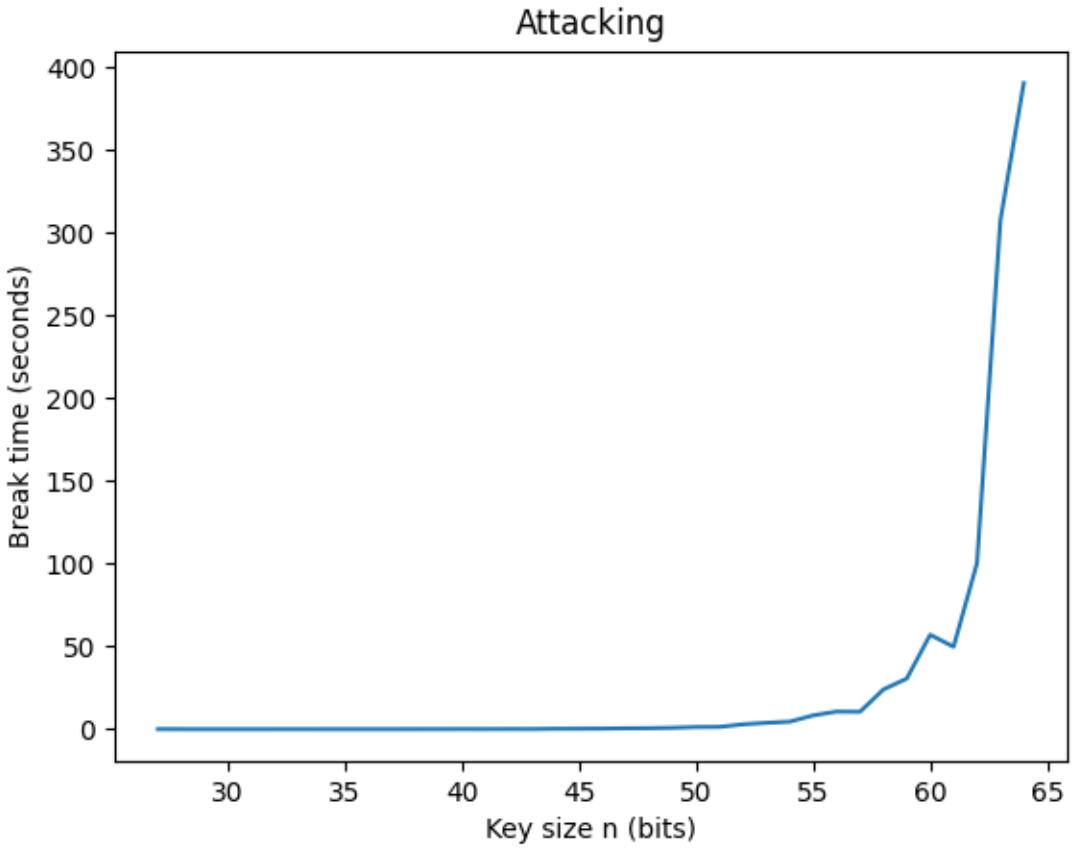
Comment:

Time of encryption/decryption increases exponentially with increasing of size of n.

This is more obvious when increasing the size of n and increasing the number of samples taken.

but it is still a short time (milliseconds), which makes the algorithm efficient in encryption/decryption.

Attack Analysis:



Comment:

Time of factorizing n and get d increases exponentially with increasing of size of n.

Sizes until 60 bits, can be broken in a few seconds.

But with increasing the size of n, it takes minutes to hours to get broken.

Which shows us how much RSA algorithm is secure.

And keys of large size such as 512 or 1024 are secure enough to be used if we have computational power and the message will not be useful after days.

Note:

The attack may take more time because it's implemented without a built-in function to factorize n.

This is the function of factorizing n and get private key d:

```
# function to factoerize n to get p,q then calculate d
def get_private_key(n,e):

    # check on primes from 2 to sqrt(n)
    for p in range(2, int(decimal.Decimal(n).sqrt())+1):
        if n % p == 0:
            q = n//p
            break

    # calculate private key using obtaind p,q
    phi=(p-1)*(q-1)
    d = rsa.mod_inverse(e,phi)
    return (d)
```

Size of n (bits)	Time of factorizing n (seconds)	Size of n (bits)	Time of factorizing n (seconds)
27	0.033323049545288086	46	0.31319713592529297
28	0.0010292530059814453	47	0.5238082408905029
29	0.0	48	0.5946090221405029
30	0.0009968280792236328	49	0.8407526016235352
31	0.001994609832763672	50	1.2717883586883545
32	0.0019941329956054688	51	1.3695220947265625
33	0.0029916763305664062	52	2.924539089202881
34	0.00498652458190918	53	3.8131909370422363
35	0.005982637405395508	54	4.522801876068115
36	0.008975744247436523	55	8.31354546546936
37	0.008977651596069336	56	10.614036798477173
38	0.017951488494873047	57	10.497321367263794
39	0.028954744338989258	58	23.959632873535156
40	0.06283211708068848	59	30.55836796760559
41	0.05002140998840332	60	57.029027700424194
42	0.08877754211425781	61	49.759361267089844
43	0.07183837890625	62	100.24110698699951
44	0.22040915489196777	63	307.27827858924866
45	0.26030445098876953	64	390.27000403404236