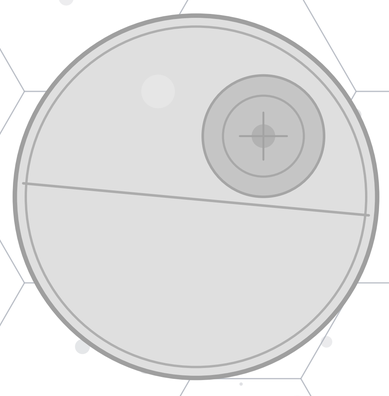


Locked Out

STAR WARS

Those rebel scum continue to scourge the galaxy. Locate their base so that we can wipe them out and bring peace and security to the empire.

Complete each of the following tasks. If you fail — you will answer to Lord Vader. It is recommended to achieve these tasks *in order*, but feel free to divide tasks to conquer the galaxy.

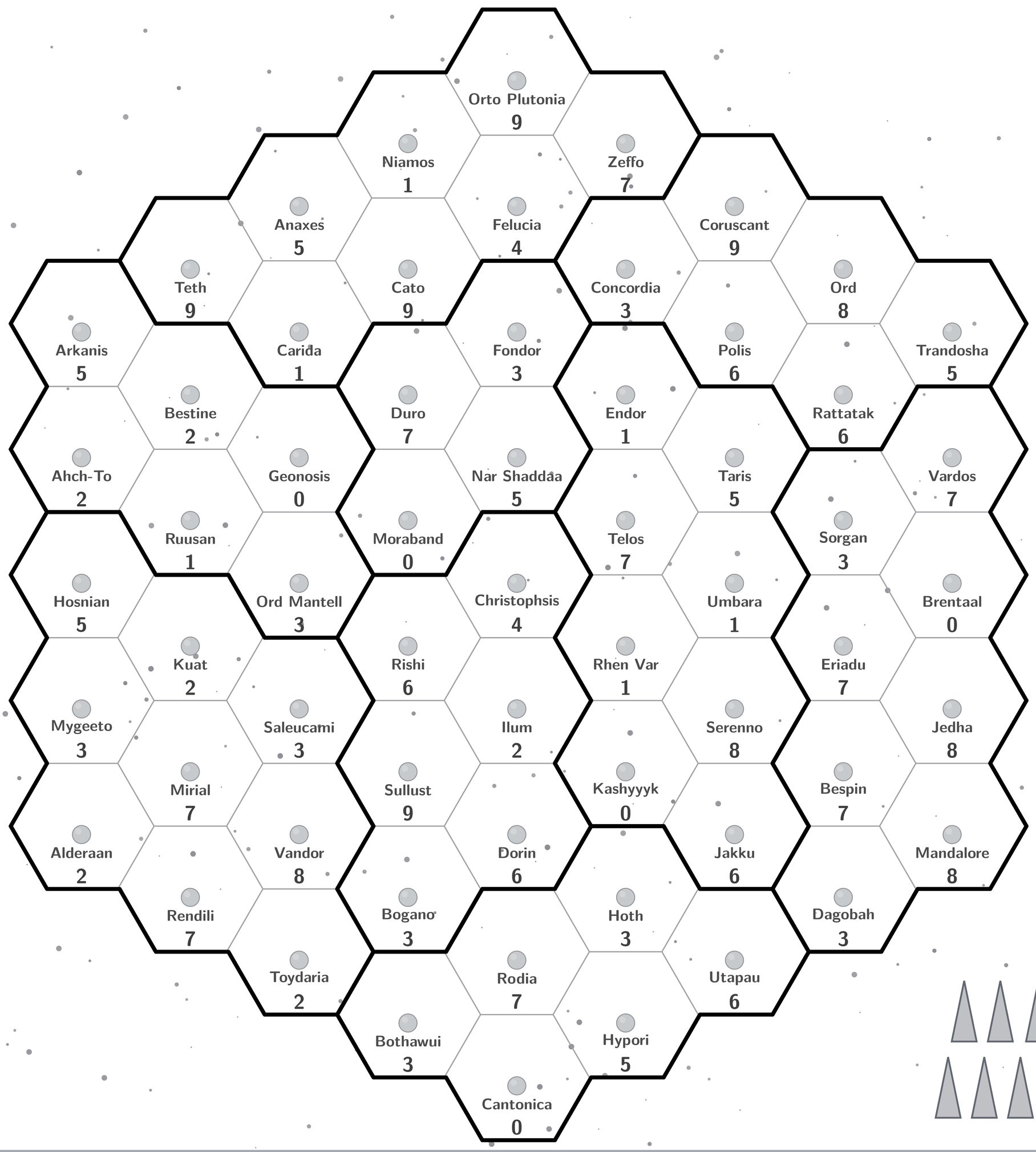
1. **Coordinate the Fleet:** Place star destroyers to secure a sector of the galaxy.
2. **Probe Retrieval:** Lock on to probe droids transmitting information.
3. **Galactic Reconnaissance:** Pin point the 7 potential systems where the rebels are hiding.
4. **locate the rebel base:** Analyze probe data to determine which system is the most probable to have the rebel base.
5. **Attack Inference:** Ensure we defeat them with *probability* on our side.

$$\sum[\text{Coordinated Fleet}] + \sum[\text{Probes Retrieved}] + \sum[\text{Recon}] + S_{\text{rebel}} + R_{\#} + n_{\text{attempts}} \quad = \quad \boxed{\text{FINAL ANSWER}}$$

COORDINATE THE FLEET

Deploy *Star Destroyers* to secure this contested sector of the galaxy and assert Imperial control.

- Each column and two diagonal rows must contain exactly one Star Destroyer.
- Each command sector (outlined by thick borders) must contain exactly one Star Destroyer.
- Star Destroyers may not occupy adjacent systems.



Each *system* shows a 1-digit number. After placing all Star Destroyers, add the codes for systems that contain them:

$$\sum[\text{Coordinated Fleet}] = (\text{sum of the digits in the Star Destroyer hexes}).$$

PROBE RETRIEVAL

Imperial probe droids are transmitting active signal counts from systems across this sector.

Each number represents the total number of active probe droids detected in that system – this is its *system value*. Together, these readings must form a complete sequence from *1* to *36*. Some signal counts have already been confirmed. You'll want to review *Galactic Reconnaissance*.

Restore the missing readings so that consecutive numbers in the sequence are located in *touching* systems. Two systems are considered touching only if they share a common edge; diagonal contact does not qualify.

In the grid above, a system is considered *probed* if it contains a probe droid.

$$\sum[\text{Probes Retrieved}] \;=\; \sum(\text{Probed system values})$$

GALACTIC RECONNAISSANCE

Identify the seven systems that are candidates for the Rebel base using *intel*. Do not forget to *coordinate the fleet* before finalizing your list.

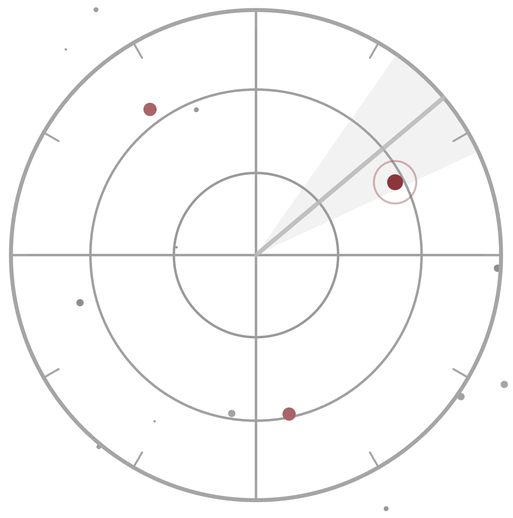
Vjun 40
Scarif 12
Orto Plutonia 19
Lah'mu 11
Mustafar 30
Exegol 28
Corellia 25
Pantora 12
Niamos 31
Zeffo 17
Pijal 30
Dantooine 30
Skako 15
Anaxes ?
Felucia ?
Coruscant ?
Raxus 25
Ringo Vinda 16
Florrum 25
Teth 29
Cato ?
Concordia ?
Ord ?
Mimban 38
Arkanis 15
Carida ?
Fondor 11
Polis 22
Trandosha 15
Zygerria 38
Byss 15
Bestine 12
Duro ?
Endor ?
Rattatak ?
Dathomir 28
Ahch-To 42
Geonosis ?
Nar Shaddaa ?
Taris ?
Vardos 17
Takodana 16
Pasaana 19
Ruusan 21
Moraband 5
Telos ?
Sorgan ?
Kef Bir 13
Hosnian 25
Ord Mantell ?
Christophsis ?
Umbara 8
Brentaal 40
Kijimi 13
Lothal 39
Kuat 32
Rishi ?
Rhen Var ?
Eriadu ?
Batuu 17
Mygeeto 33
Saleucami 1
Ilum ?
Serenno ?
Jedha 38
Crait 17
Onderon 11
Mirial 37
Sullust ?
Kashyyyk ?
Bespin 26
Yavin 25
Alderaan 32
Vandor 36
Dorin ?
Jakku ?
Mandalore 38
Tund 22
Coruscantia 35
Rendili 17
Bogano ?
Hoth 33
Dagobah ?
Rakata Prime 35
Kessel 35
Toydaria 32
Rodia 17
Utapau 26
Tatooine 33
Kamino 19
Mon Calamari 38
Nal Hutta 32
Bothawui 23
Hypori 25
Ryloth 12
Naboo 35
Cantonica

$$\sum[\text{Recon}] = \sum \text{Candidate System Values}$$

LEGEND

- TIE fighter
- Star Destroyer
- Super Star Destroyer
- Death Star
- X-wing
- Mon Calamari cruiser
- System
- (2) System value

Coordinate the Fleet



LOCATE THE REBEL BASE

Imperial probe droids are transmitting incident information readings from across the galaxy. *Your previous work* should have identified seven candidate systems where the rebel base could be hidden, along with corresponding system values.

In the table below, circle a set of numbers so that every row and every column matches its required total. Any number that is not circled is treated as excluded (treated as having no probe droids).

System names (A → G)	Transmitted Information type ▲	■	♦	✳	●	▼	◀	System Value
	9	6	7	5	4	7	4	◯
	1	8	8	6	7	3	4	◯
	5	8	2	3	2	2	2	◯
	7	9	1	3	8	3	8	◯
	2	7	3	5	2	4	1	◯
	8	7	5	1	3	2	8	◯
	1	2	3	6	5	4	8	◯
Column totals	24	38	18	15	12	21	29	

Information Key

- ▲ Dangerous lifeforms
- ■ Rebel sabotage
- ♦ Unstable planetary conditions
- ✳ Smuggler traffic
- ● Patrol gaps
- ▼ Encrypted bursts
- ◀ Ion storm activity

For each system, define the rebellion probability by

$$p_{\text{rebellion}} = P(\text{Rebel sabotage} \mid \text{System})$$

The rebel base is located on the candidate system with the largest rebellion probability.

$$S_{rebel} = \text{system value for the rebel base}$$

Systems are considered *risky* if $P(\text{System} \mid ♦) > 0.2$.

$$R_{\#} = \text{Number of } \textit{risky} \text{ systems}$$

FINAL ASSAULT

IMPERIAL HIGH COMMAND — OPERATIONAL DOSSIER

DESCRIPTION

Commander, rebel scum have fortified their base and are wagering their lives on chance. You will show them what inevitability looks like.

Each starship on the map (*galactic recon*) represents a vessel with a battle competency value. For each ship type, competency has a particular probability distribution. Ships act independently; ships are i.i.d. You'll want to refer to *specifications*.

DEFINITIONS

- Let S_I be the total Imperial fleet competency (sum of competencies of all participating Imperial ships, Don't forget to include the 9 Star Destroyers assigned during *Coordinate the Fleet*).
- Let S_R be the total Rebel fleet competency (sum of competencies of all participating Rebel ships).
- An assault attempt succeeds if $S_I > S_R$.

$$p_{\text{win}} = \mathbb{P}(S_I > S_R).$$

- Let N be the number of assault attempts required for the Empire to defeat the rebels. Each attempt is independent with success probability p_{win}.

ANSWER

Answer this puzzle using the expected number of assault attempts required to defeat the rebels (rounded to the nearest attempt)

$$n_{\text{attempts}} = \mathbb{E}[N].$$

STANDARD NORMAL PROBABILITIES

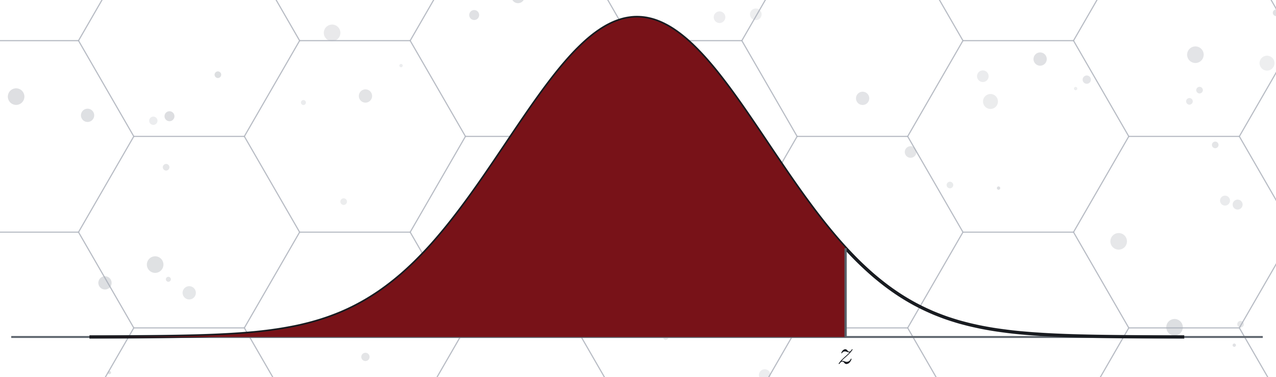


Table A (positive z): entries give $P(Z \leq z)$.

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998