

1843

## THE GOLD-BUG

Edgar Allan Poe

***This is challenge is for students who are about to end their first year of study of GCSE Computer Science.***

The methods that are described in this story have been used to encrypt the following important message (not with the same cipher).

\$%!<]%!<>%.)(/:%]/?!,(!@%!@%<]~//\$(/,)\$!]!.\$<%>?<.>/=#(//,&%%,).~<%=>%\$!.\$<%&<%=(%\$!.\$<%!\$]&/<]%!<%,%@%.

Your challenge is to adapt and use those methods and decrypt this message!

MANY years ago, I contracted an intimacy with a Mr. William Legrand. He was of an ancient Huguenot family, and had once been wealthy; but a series of misfortunes had reduced him to want. To avoid the mortification consequent upon his disasters, he left New Orleans, the city of his forefathers, and took up his residence at Sullivan's Island, near Charleston, South Carolina. This Island is a very singular one. It consists of little else than the sea sand, and is about three miles long. Its breadth at no point exceeds a quarter of a mile.

Not far from the eastern or more remote end of this island, Legrand had built himself a small hut, which he occupied when I first, by mere accident, made his acquaintance. This soon ripened into friendship—for there was much in the recluse to excite interest and esteem. I found him well educated, with unusual powers of mind, but infected with misanthropy, and subject to perverse moods of alternate enthusiasm and melancholy.

About the middle of October, 18—, there occurred, however, a day of remarkable chilliness. Just before sunset I scrambled my way through the evergreens to the hut of my friend, whom I had not visited for several weeks

Legrand was in one of his fits—how else shall I term them?—of enthusiasm. He had found an unknown bivalve, forming a new genus, and, more than this, he had hunted down and secured a scarabaeus which he believed to be totally new, but in respect to which he wished to have my opinion on the morrow. "And why not to-night?" I asked, rubbing my hands over the blaze, and wishing the whole tribe of scarabaei at the devil.

"this will answer"; and he drew from his waistcoat pocket a scrap of what I took to be very dirty foolscap, and made upon it a rough drawing with the pen. While he did this, I retained my seat by the fire, for I was still chilly. When the design was complete, he handed it to me without rising. As I received it, a loud growl was heard, succeeded by a scratching at the door. He opened it, and a large Newfoundland rushed in, leaped upon my shoulders, and loaded me with caresses; for I had shown him much attention during previous visits. When his gambols were over, I looked at the paper, and, to speak the truth, found myself not a little puzzled at what my friend had depicted. "Well!" I said, after contemplating it for some minutes, "this is a strange scarabaeus, I must confess: new to me: never saw anything like it before—unless it was a skull, or a death's-head—which it more nearly resembles than anything else that has come under my observation." "A death's-head!" echoed Legrand.

He received the paper very peevishly, and was about to crumple it, apparently to throw it in the fire, when a casual glance at the design seemed suddenly to rivet his attention. In an instant his face grew violently red—in another as excessively pale. For some minutes he continued to scrutinize the drawing minutely where he sat. At length he arose, took a candle from the table, and proceeded to seat himself upon a sea-chest in the farthest corner of the room.

He became more and more absorbed in reverie, from which no sallies of mine could arouse him. It had been my to pass the night at the hut, as I had frequently done before, but, seeing my host in this mood, I deemed it proper to take leave. He did not press me to remain, but, as I departed, he shook my hand with even more than his usual cordiality.

It was about a month after this (and during the interval I had seen nothing of Legrand) when I received a vi a note which ran thus:

**My DEAR —**

***Why have I not seen you for so long a time? I hope you have not been so foolish as to take offence at any little brusquerie of mine; but no, that is improbable. Since I saw you I have had great cause for anxiety. I have something to tell you, yet scarcely know how to tell it, or whether I should tell it at all.***

***If you can, in any way, make it convenient, come over. Do come. I wish to see you tonight, upon business of importance. I assure you that it is of the highest importance. Ever yours, WILLIAM LEGRAND.***

I made my way with some hast and after some inquiries respecting his health, I asked him, not knowing what better to say, if he had yet obtained the scarabaeus from Lieutenant G—. “Oh, yes,” he replied, coloring violently, “I got it from him the next morning. Nothing should tempt me to part with that scarabaeus.

“This bug is to make my fortune,” he continued, with a triumphant smile, “to reinstate me in my family possessions. Is it any wonder, then, that I prize it? Since Fortune has thought fit to bestow it upon me, I have only to use it properly and I shall arrive at the gold of which it is the index.

Hereupon Legrand arose, with a grave and stately air, and brought me the beetle from a glass case in which it was enclosed. It was a beautiful scarabaeus, and, at that time, unknown to naturalists —of course a great prize in a scientific point of view. There were two round, black spots near one extremity of the back, and a long one near the other. The scales were exceedingly hard and glossy, with all the appearance of burnished gold. The weight of the insect was very remarkable; but what to make of Legrand’s opinion, I could not, for the life of me, tell.

“I sent for you,” said he, in a grandiloquent tone, when I had completed my examination of the beetle, “I sent for you, that I might have your counsel and assistance in furthering the views of Fate and of the bug”— “My dear Legrand,” I cried, interrupting him, “you are certainly unwell, and had better use some little precautions. You shall go to bed, and I will remain with you a few days, until you get over this. You are feverish and”— “Feel my pulse,” said he. I felt it, and, to say the truth, found not the slightest indication of fever.

We are going upon an expedition into the hills, upon the main land, and, in this expedition, we shall need the aid of some person in whom we can confide. You are the only one we can trust. Whether we succeed or fail, the excitement which you now perceive in me will be equally allayed.” “I am anxious to oblige you in any way,” I replied; “but do you mean to say that this infernal beetle has any connection with your expedition into the hills?” “It has.” “Then, Legrand, I can become a party to no such absurd proceeding. “I am sorry —very sorry.” “Then I shall go alone”. “Try it by yourself! You are surely mad! —but stay! —how long do you propose to be absent?” “Probably all night. We shall start immediately, and be back, at all events, by sunrise.” And so, it was I was persuaded to accompany my friend.

We crossed the creek at the head of the island by means of a skiff, and, ascending the high grounds on the shore of the mainland, proceeded in a northwesterly direction, through a tract of country excessively wild and desolate, where no trace of a human footstep was to be seen. Legrand led the way with decision; pausing only for an instant, here and there, to consult what appeared to be certain landmarks of his own contrivance upon a former occasion. In this manner we journeyed for

about two hours, and the sun was just setting when we entered a region infinitely more dreary than any yet seen.

The natural platform to which we had clambered was thickly overgrown with brambles, through which we soon discovered that it would have been impossible to force our way but for the scythe we brought along. We proceeded to clear a path to the foot of an enormously tall tuliptree, which stood, with some eight or ten oaks, upon the level, and far surpassed them all, and all other trees which I had then ever seen, in the beauty of its foliage and form, in the wide spread of its branches, and in the general majesty of its appearance.

Now I must climb said he, while I dumbstruck, stood frozen in place, too shocked to utter a word of protest.

In youth, the tulip-tree, or Liriodendron Tulipiferum, the most magnificent of American foresters, has a trunk peculiarly smooth, and often rises to a great height without lateral branches; but, in its riper age, the bark becomes gnarled and uneven, while many short limbs make their appearance on the stem. Thus the difficulty of ascension, in the present case, lay more in semblance than in reality.

Embracing the huge cylinder, as closely as possible, with his arms and knees, seizing with his hands some projections, and resting his toes upon others, he, after one or two narrow escapes from falling, at length wriggled himself into the first great fork and eventually made his way out to the end of the furthestmost limb of the tree.

From here he held up the beetle to his left eye and let it drop while holding on to a length of string to which it was attached. He then returned to the ground and driving a peg, with great nicety, into the ground, at the precise spot where the beetle fell, my friend now produced from his pocket a tape-measure. Fastening one end of this at that point of the trunk of the tree which was nearest the peg, he unrolled it till it reached the peg, and thence farther unrolled it, in the direction already established by the two points of the tree and the peg, for the distance of fifty feet.

Taking now a spade himself, and giving one to me, Legrand begged me to set about one to digging as quickly as possible.

To speak the truth, I had no especial relish for such amusement at any time, and, at that particular moment, would most willingly have declined it; for the night was coming on, and I felt much fatigued with the exercise already taken; but I saw no mode of escape, and was fearful of disturbing my poor friend’s equanimity by a refusal.

The lanterns having been lit, we fell to work with a zeal worthy a more rational cause; and, as the glare fell upon our persons and implements, I could not help thinking how picturesque a pair we composed, and how strange and suspicious our labors must have appeared to any interloper who, by chance, might have stumbled upon our whereabouts.

When we had been at work perhaps an hour and a half, we were again interrupted by the violent howlings of his dog. His uneasiness, in the first instance, had been, evidently, but the result of playfulness or caprice, but he now assumed a bitter and serious tone and, leaping into the hole, tore up the ground frantically with his claws. In a few seconds he had uncovered a mass of human bones, forming two complete skeletons, intermingled with several buttons of metal, and what appeared to be the dust of decayed woollen. One or two strokes of a spade upturned the blade of a large Spanish knife, and, as we dug farther, three or four loose pieces of gold and silver coin came to light.

We now worked in earnest, and never did I pass ten minutes of more intense excitement. During this interval we had fairly unearthed an oblong chest of wood, which, from its perfect preservation, and wonderful hardness, had plainly been subjected to some mineralizing process. This box was three feet and a half long, three feet broad, and two and a half feet deep. It was firmly secured by bands of wrought iron, riveted, and forming a kind of trellis-work over the whole. On each side of the chest, near the top, were three rings of iron —six in all —by means of which a firm hold could be obtained by six persons. Our utmost united endeavors served only to disturb the coffer very slightly in its bed. We at once saw the impossibility of removing so great a weight. Luckily, the sole fastenings of the lid consisted of two sliding bolts.

These we drew back —trembling and panting with anxiety. In an instant, a treasure of incalculable value lay gleaming before us. As the rays of the lanterns fell within the pit, there flashed upwards, from a confused heap of gold and of jewels, a glow and a glare that absolutely dazzled our eyes. I shall not pretend to describe the feelings with which I gazed. Amazement was, of course, predominant. Legrand appeared exhausted with excitement, and spoke very few words.

It became necessary, at last, that I should arouse him to the expediency of removing the treasure. It was growing late, and it behooved us to make exertion, that we might get everything housed before daylight. It was difficult to say what should be done; and much time was spent in deliberation — so confused were the ideas of all. We, finally, lightened the box by removing two thirds of its contents, when we were enabled, with some trouble, to raise it from the hole. The articles taken out were deposited among the brambles, and the dog left to guard them.

We estimated the entire contents of the chest, that night, at a million and a half of dollars; and, upon the subsequent disposal of the trinkets and jewels (a few being retained for our own use), it was found that we had greatly undervalued the treasure. When, at length, we had concluded our examination, and the intense excitement of the time had, in some measure, subsided, Legrand, who saw that I was dying with impatience for a solution of this most extraordinary riddle, entered into a full detail of all the circumstances connected with it.

“You remember,” said he, “the night when I handed you the rough sketch I had made of the scarabaeus. You recollect also, that I became quite vexed at you for insisting that my drawing resembled a death’s-head. When you first made this assertion I thought you were jesting; but afterwards I called to mind the peculiar spots on the back of the insect, and admitted to myself that your remark had some little foundation in fact. Still, the sneer at my graphic powers irritated me — for I am considered a good artist —and, therefore, when you handed me the scrap of parchment, I was about to crumple it up and throw it angrily into the fire.”

“The scrap of paper, you mean,” said I. “No; it had much of the appearance of paper, and at first I supposed it to be such, but when I came to draw upon it, I discovered it, at once, to be a piece of very thin parchment. It was quite dirty, you remember. Well, as I was in the very act of crumpling it up, my glance fell upon the sketch at which you had been looking, and you may imagine my astonishment when I perceived, in fact, the figure of a death’s-head just where, it seemed to me, I had made the drawing of the beetle. For a moment I was too much amazed to think with accuracy. I knew that my design was very different in detail from this —although there was a certain similarity in general outline. Presently I took a candle, and seating myself at the other end of the room, proceeded to scrutinize the parchment more closely.

I began distinctly, positively, to remember that there had been no drawing on the parchment when I made my sketch of the scarabaeus. I became perfectly certain of this; for I recollected turning up first one side and then the other, in search of the cleanest spot.

“When you had gone, I betook myself to a more methodical investigation of the affair. In the first place I considered the manner in which the parchment had come into my possession. The spot where I discovered the scarabaeus was on the coast of the main land, about a mile eastward of the island, and but a short distance above high water mark. Upon my taking hold of it, it gave me a sharp bite, which caused me to let it drop. It was at this moment that my eyes fell upon the scrap of parchment, which I then supposed to be paper. It was lying half buried in the sand, a corner sticking up. Near the spot where we found it, I observed the remnants of the hull of what appeared to have been a ship’s long boat. The wreck seemed to have been there for a very great while; for the resemblance to boat timbers could scarcely be traced.

“No doubt you will think me fanciful —but I had already established a kind of connexion. I had put together two links of a great chain. There was a boat lying on a sea-coast, and not far from the boat was a parchment —not a paper —with a skull depicted on it. You will, of course, ask ‘where is the connexion?’ I reply that the skull, or death’s-head, is the well-known emblem of the pirate. The flag of the death’s-head is hoisted in all engagements.

“But,” I interposed, “you say that the skull was not upon the parchment when you made the drawing of the beetle. How then do you trace any connexion between the boat and the skull —since this latter, according to your own admission, must have been designed (God only knows how or by whom) at some period subsequent to your sketching the scarabaeus?” “Ah, hereupon turns the whole mystery; although the secret, at this point, I had comparatively little difficulty in solving.

“At this stage of my reflections I endeavored to remember, and did remember, with entire distinctness, every incident which occurred about the period in question. The weather was chilly (oh rare and happy accident!), and a fire was blazing on the hearth. I was heated with exercise and sat near the table. You, however, had drawn a chair close to the chimney. Just as I placed the parchment in your hand, and as you were in the act of inspecting it, Wolf, the Newfoundland, entered, and leaped upon your shoulders. With your left hand you caressed him and kept him off, while your right, holding the parchment, was permitted to fall listlessly between your knees, and in close proximity to the fire. At one moment I thought the blaze had caught it, and was about to caution you, but, before I could speak, you had withdrawn it, and were engaged in its examination. When I considered all these particulars, I doubted not for a moment that heat had been the agent in bringing to light, on the parchment, the skull which I saw designed on it.

I immediately kindled a fire, and subjected every portion of the parchment to a glowing heat. At first, the only effect was the strengthening of the faint lines in the skull; but, on persevering in the experiment, there became visible, at the corner of the slip, diagonally opposite to the spot in which the death’s-head was delineated, the figure of what I at first supposed to be a goat. A closer scrutiny, however, satisfied me that it was intended for a kid.”

“You may have heard of one Captain Kidd. I at once looked on the figure of the animal as a kind of punning or hieroglyphical signature.

You have heard, of course, the many stories current —the thousand vague rumors afloat about money buried, somewhere on the Atlantic coast, by Kidd and his associates. These rumors must have had some foundation in fact.

I carefully rinsed the parchment by pouring warm water over it, and, having done this, I placed it in a tin pan, with the skull downwards, and put the pan upon a furnace of lighted charcoal. In a few minutes, the pan having become thoroughly heated, I removed the slip, and, to my inexpressible joy, found it spotted, in several places, with what appeared to be figures arranged in lines. Again I placed it in the pan, and suffered it to remain another minute. On taking it off, the whole was just as you see it now." Here Legrand, having re-heated the parchment, submitted it to my inspection. The following characters were rudely traced, in a red tint, between the death'shead and the goat:

53‡‡†305))6\*;4826)4‡.‡4‡);80  
6\*;48†8¶(60))85;1‡(;‡\*8†83(88)  
5\*†;46(;88\*96\*‡;8)\*‡(;485);5\*†  
2:\*‡(;4956\*2(5\*-4)8¶8\*;40692  
85);)6†8)4‡‡;1(‡9;48081;8:8‡1  
;48†85;4)485†528806\*81(‡9;48  
;(88;4(‡?34;48)4‡;161;:188;‡?;

"But," said I, returning him the slip, "I am as much in the dark as ever. Were all the jewels of Golconda awaiting me on my solution of this enigma, I am quite sure that I should be unable to earn them." "And yet," said Legrand, "the solution is by no means so difficult as you might be led to imagine from the first hasty inspection of the characters. These characters, as any one might readily guess, form a cipher—that is to say, they convey a meaning; but then, from what is known of Kidd, I could not suppose him capable of constructing any of the more abstruse cryptographs. I made up my mind, at once, that this was of a simple species—such, however, as would appear, to the crude intellect of the sailor, absolutely insoluble without the key." "And you really solved it?" "Readily; I have solved others of an abstruseness ten thousand times greater.

"In the present case—indeed in all cases of secret writing—the first question regards the language of the cipher; for the principles of solution, so far, especially, as the more simple ciphers are concerned, depend on, and are varied by, the genius of the particular idiom. In general, there is no alternative but experiment (directed by probabilities) of every tongue known to him who attempts the solution, until the true one be attained. But, with the cipher now before us, all difficulty is removed by the signature. The pun on the word 'Kidd' is appreciable in no other language than the English. But for this consideration I should have begun my attempts with the Spanish and French, as the tongues in which a secret of this kind would most naturally have been written by a pirate of the Spanish main. As it was, I assumed the cryptograph to be English.

"You observe there are no divisions between the words. Had there been divisions, the task would have been comparatively easy. In such case I should have commenced with a collation and analysis of the shorter words, and, had a word of a single letter occurred, as is most likely, (a or I, for example,) I should have considered the solution as assured. But, there being no division, my first step was to ascertain the predominant letters, as well as the least frequent. Counting all, I constructed a table, thus: -

Of the character 8 there are 33.

;	"	26.
4	"	19.
)	"	16.
‡	"	16.
*	"	13.
5	"	12.
6	"	11.
†	"	8.
1	"	8.
0	"	6.
9	"	5.
2	"	5.
:	"	4.
?	"	3.
¶	"	2.
-	"	1.
.	"	1.

"Now, in English, the letter which most frequently occurs is e. Afterwards, the succession runs thus: a o i d h n r s t u y c f g l m w b k p q x z. E however predominates so remarkably that an individual sentence of any length is rarely seen, in which it is not the prevailing character.

"Here, then, we have, in the very beginning, the groundwork for something more than a mere guess. The general use which may be made of the table is obvious --but, in this particular cipher, we shall only very partially require its aid. As our predominant character is 8, we will commence by assuming it as the e of the natural alphabet. To verify the supposition, let us observe if the 8 be seen often in couples --for e is doubled with great frequency in English --in such words, for example, as 'meet,' 'fleet,' 'speed,' 'seen,' 'been,' 'agree,' &c. In the present instance we see it doubled less than five times, although the cryptograph is brief.

"Let us assume 8, then, as e. Now, of all words in the language, 'the' is the most usual; let us see, therefore, whether they are not repetitions of any three characters in the same order of collocation, the last of them being 8. If we discover repetitions of such letters, so arranged, they will most probably represent the word 'the.' On inspection, we find no less than seven such arrangements, the characters being ;48. We may, therefore, assume that the semicolon represents t, that 4 represents h, and that 8 represents e --the last being now well confirmed. Thus a great step has been taken.

"But, having established a single word, we are enabled to establish a vastly important point; that is to say, several commencements and terminations of other words. Let us refer, for example, to the last instance but one, in which the combination ;48 occurs --not far from the end of the cipher. We know that the semicolon immediately ensuing is the commencement of a word, and, of the six characters succeeding this 'the,' we are cognizant of no less than five. Let us set these characters down, thus, by the letters we know them to represent, leaving a space for the unknown--

t eeth

"Here we are enabled, at once, to discard the 'th,' as forming no portion of the word commencing with the first t; since, by experiment of the entire alphabet for a letter adapted to the vacancy we perceive that no word can be formed of which this th can be a part. We are thus narrowed into

t ee

and, going through the alphabet, if necessary, as before, we arrive at the word 'tree,' as the sole possible reading. We thus gain another letter, r, represented by (, with the words 'the tree' in juxtaposition.

"Looking beyond these words, for a short distance, we again see the combination ;48, and employ it by way of termination to what immediately precedes. We have thus this arrangement:

the tree ;4(‡?34 the,

or substituting the natural letters, where known, it reads thus:

the tree thr‡?3h the.

"Now, if, in place of the unknown characters, we leave blank spaces, or substitute dots, we read thus:

the tree thr . . . h the,

when the word 'through' makes itself evident at once. But this discovery gives us three new letters, o, u and g, represented by ‡ ? and 3.

"Looking now, narrowly, through the cipher for combinations of known characters, we find, not very far from the beginning, this arrangement,

83(88, or egree,

which, plainly, is the conclusion of the word 'degree,' and gives us another letter, d, represented by †.

"Four letters beyond the word 'degree,' we perceive the combination

;46(;88\*

"Translating the known characters, and representing the unknown by dots, as before, we read thus:

th . rtee .

an arrangement immediately suggestive of the word 'thirteen,' and again furnishing us with two new characters, i and n, represented by 6 and \*.

"Referring, now, to the beginning of the cryptograph, we find the combination,

53‡††

"Translating, as before, we obtain

. good,

which assures us that the first letter is A, and that the first two words are 'A good.'

"To avoid confusion, it is now time that we arrange our key, as far as discovered, in a tabular form. It will stand thus:

5 represents a

† " d

8 " e

3 " g

4 " h

6 " i

\* " n

‡ " o

( " r

; " t

"We have, therefore, no less than ten of the most important letters represented, and it will be unnecessary to proceed with the details of the solution. I have said enough to convince you that ciphers of this nature are readily soluble, and to give you some insight into the rationale of their development. But be assured that the specimen before us appertains to the very simplest species of cryptograph. It now only remains to give you the full translation of the characters upon the parchment, as unriddled. Here it is:

'A good glass in the bishop's hostel in the devil's seat forty-one degrees and thirteen minutes northeast and by north main branch seventh limb east side shoot from the left eye of the death's-head a bee line from the tree through the shot fifty feet out.'"

## Goldbug Cipher Tasks

The methods that are described in this story have been used to encrypt the following important message (not with the same cipher).

\$%!<]%!<>%.)/[:%]/?!,,(!@%!@%<]~//\$(/,)\$!]!.\$<%>?<.>/=#(//,&%%,).~<%=>%\$!.\$<%&<%=(%\$!.\$<%!\$]&/<]%!<%,%@%.

...but there is a problem! This message does not contain enough characters to allow a meaningful analysis of the number of characters and the probability of each character representing an English character.

Luckily a much longer story has also been encrypted using the same key. There is also a vb.net program that will count how many characters there are in that story.

If you are clever, you should be able to use the frequency (count) of the letters in this story to make educated guesses about the most likely letter that is represented in this message.

If you are very clever, you might be able to write a program that can decrypt the encrypted message!

Visit: <https://github.com/srichardstchs/GoldbugCipher>

Step 1: Download the short and long encrypted messages and save them to your OneDrive.

Step 2: Copy the vb.net program and run it on the long-encrypted message. (There is no need to try to decrypt this long message at this point)

Step 3: Use the frequency of encrypted chatacters in the long message to help you crack the cipher and unlock the short message.