

LAB QUIZ

Build a class called **LinkedListDecoder**.

Following this, there are 5 stages of challenges, each with increasing levels of difficulty. Quiz marks will be calculated as follows. Note that the tasks must be completed in order.

1. Complete challenge 1 = $\frac{1}{5}$
2. Complete challenge 2 = $\frac{2}{5}$
3. Complete challenge 3 = $\frac{3}{5}$
4. Complete challenge 4 = $\frac{4}{5}$
5. Optimization of algorithm = Full marks

After every challenge, you may check your answer at the link below to validate your code. If your code outputs the correct sequence, you will get 'CORRECT!' alert, and if your answer is wrong, you will get 'Wrong.. Try Again!'

<https://desmondyeoh.github.io/ta-datastruct-quiz/index2.html>

(NOTE: CHECK THAT IT IS WRITTEN SET B IN THE TITLE)

Restrictions

- You must implement your answer in LinkedList data structure.
- You must not use String manipulation techniques to get the final answer.

CHALLENGE 1

```
addString(String str);
```

- Just split `str` into characters and add each character to the linked list.
- Let the head points to first character of `str` and tail points to last character of `str`.

```
toString();
```

- Override the `toString` method to print out all the nodes in the linked list to a one-line string, with each character printed out **twice**.
- For example, `'a' -> 'b' -> 'c'` will print out `aabbcc`

Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("hqivjutvzshjwrmoybsdmrqxkfielwvfccgemrrowgewxzrqtuxibewdj1geqqjgoghbcuihzvayftaa
finaczblfryugonlxcccuzgppplventdkzxgfcxyrplikyskqcmurwflzggsjwbubboaxpkhcbunscoermwbhvjkcrygxc
aefmikeefenbeylahidynnwtvtmredblrvhoauxlmqmf1luyieeuofhxjphdpslwmrhfuwmnlsmitybadajhhuwjfpjems
aaqudwhbhobpilkj1dtpvtkvjvfbjxzxidboswlmqkqzdzgefnnfwibpuotqycjhbznzdkwcnvtdzwlbsawojfzsimhcai
xylushocnowwqnlxmpqrxfsjszpromycatcyefiuhcxssvcefgxcjiiquckebpbkxadgcmryrkxqekhuqhqqvrtpraqzhd
kvmpwuapvduljzxlryfzmvzlvpygoquncckxuhzxcdkiehpunqmqmagzsghakgfmvbyxtvtkmygknogferfbxucznztypjt
poucudnufrxdracjdpykyfyrunvrjexpwxihwiwukfesifmxlasrknhfwsaznsysitsnqgrmywxlnoznuqtkzhpooxoulv
finadjignmngnvjzccikccwqtkdrcgzxosyvprefjbbhlvatdhpsklcniafgcnbghzcrj1bwyt1otfwzmp1tqdiinxqyzbyg
vqgzqghr1qyh1hzzggpsfmwaqawtiaeu1dwei1q1tryidpxncsmicfbxupdfg1j1bv1kostxei1yko1nduxmtoaahvclkw1d1nsyns
vzihepfqenwidcvd1qsvjowbasoesbj1ljewoxbofsl1nhqv1j1zgb1gldqpplmiutj1fct1juh1zrvsdnasbluaqtrdbpljdsj
obcmjwpet1cypgciixskokdwnygcaptqmqmfoqdj1qklcbmapna1jstl1j1pripwedtkyexnuzclmsxrstwlz1fdq1xovupakzrrm
qiaorbaaofvmucrwuzoqrmcfbvmawpyvoysl1fhfmvgokij1bwdlokzaxlrdsmryzpj1regf1hbczeqcgwgorkgpyqoephvvrj
bkzexqdvtfggjuofny1tssaxvvkylzuwkbh1h1khp1uwvpafkxhtmkmbke1jegzqlmbvigykufggegnysxlrzhegwyb1th1tenbm
hmddeihdavkkdym1n1grdp1ijlmevqoqcankottndritarvpeazq1t1glspegzioh1lututbj1wtoysibfmuuaj1tntzyoejjwo"
);
System.out.println(l1d);
```

HINT: Your answer will start with `hhqqiivvj1j` and end with `eejjjjwwoo`

CHALLENGE 2

A(char a, char b, int n);

- This method will add character a after the n-th occurrence of character b.
- Eg: ['f', 'c', 'f', 'g'] ⇒ A('z', 'f', 2) ⇒ ['f', 'c', 'f', 'z', 'g']
 - Add 'z' after the 2nd 'f'.
- Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("doixusirqccozwptpsfmlsljymzfsemcceknbthnlghkefjdblzxvhanbtpwxuvsrlaxpwvtxkmhpal
ajvvjgqgswcqtjyoucjtraxipebijmgfgsxmpjnpwrhmshujqkmqfmqasotykfqbweoqbmcjntszygdjzoilrhgitardgh
kwtmyjorsrhflargpxdpfxrdvttadzxxgbhncjjhpnvjigvkuosxnjvgsbjrplyxlmynvfszvnfmgsgdpysogmspkdepk
bphslasuskfbbugdwomzsoitufqkdojzlkbsuajqjpzfkscffwipftwyzniltbijtclcrxfqdzlvfadkzujubrslok1qei
klopcwnytgsswaivgtldrqi fkmxi hrezdomujmvykekzhzaufvryuobuavihqjrrxyppfuhaioodxroqhazmefxkqclkwu
lgmvl dydawzbipxptluzjhfuwdrdiokbmlzxxggezqcugxqgsmxtqyorcjoblywlzxevygcgbonyyhxicytnbqwqeinkhds
mflixuoshzxlvvrkxbwpkticbwywzjcqirtilsrowcehhdeebtoboyqbnffrycmopywqntwqmipqkqaojsirugsdvdvohwd
huyrvajjhtzdzwjvxpejletqommfxnvykyscojkhcixlwpefrihankfzxlgbznejgrbhagixcfzgxqurnpermcfjxnhekw
accuynsrabipyvlzqpvaqvyyddnnddqvirhdtmxxzgnxqxdtuhkpvtfahyzntvxxyjakfudsgknfjlyefrgsiiewfqqjucbx
grdvjtxvknmgvoiwgfevbwmygaokzpsloeumbnddiipxjztlbtdpwetbnkvogearlognmoyvsvqezhtagwpephllujwja
qvtopzdmfllomwbzalruwrbsbfwengcdqbmcztnccckcvwqncxfyydfqjdwnrqqpsuvpacqyivmfuugsabtligajqqfalcj
yuazrxphvwgcvkbowtagfdugcwoxjjwuneeppkzybtkesexwtinvuavgkhemnwushdknpltlzisubydkrdvlizmfrhigpb
fwneqtcemujhnxazqoyfovcdwmahztsmyumncaxutwuznwbhqbimeykfealeknmhnlgxilhdiucdcoqgvryubnhbauovub
ecaayosqsizenukjpmotmxisodhlqctydrwrrpexwovzjftkrxmbchbachakebymrnscyibikbphbrmertpehczpzzpgz"
);
l1d.A('e','p',5);l1d.A('n','o',45);l1d.A('u','w',4);l1d.A('r','m',30);l1d.A('p','m',13);l1d.A(
'd','j',2);l1d.A('k','a',43);l1d.A('w','p',42);l1d.A('a','x',43);l1d.A('u','u',6);l1d.A('g','w
',46);l1d.A('e','n',2);l1d.A('e','n',16);l1d.A('d','j',34);l1d.A('e','r',12);l1d.A('n','r',41)
;l1d.A('q','a',1);l1d.A('s','g',14);l1d.A('m','d',34);l1d.A('d','j',42);l1d.A('n','e',2);l1d.A
('g','o',15);l1d.A('l','c',8);l1d.A('w','h',29);l1d.A('m','d',15);l1d.A('t','r',8);l1d.A('n','
r',1);l1d.A('d','o',11);l1d.A('q','g',31);l1d.A('u','l',33);l1d.A('i','z',36);l1d.A('c','d',33
);l1d.A('k','c',23);l1d.A('f','f',37);l1d.A('z','v',27);l1d.A('h','e',16);l1d.A('l','g',51);l1
d.A('r','y',35);l1d.A('a','d',36);l1d.A('k','v',46);l1d.A('f','x',12);l1d.A('g','a',51);l1d.A(
'v','q',15);l1d.A('l','e',7);l1d.A('h','z',17);l1d.A('c','c',16);l1d.A('k','u',20);l1d.A('z','
l',3);l1d.A('y','z',51);l1d.A('y','d',37);
System.out.println(l1d);
```

HINT: Your answer will start with ddooiixxuu and end with zzypppggzz

CHALLENGE 3

B(char a, int i, int j);

- This method will remove j letters after the i-th occurrence of character a.
- Eg: ['a', 'a', 'a', 'c', 'b', 'c', 'c'] \Rightarrow B('a', 2, 4) \Rightarrow ['a', 'a', 'c']
 - Remove 4 characters ('a', 'c', 'b', 'c') after the second 'a'.
- You may assume that i+j will always be smaller than the size of linked list - 1. That is to say, you can assume the following case **will not happen**.
 - Eg: ['a', 'a', 'a', 'c', 'b'] \Rightarrow B('a', 2, 3)
- Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("veuigdfklvueyhcrpxdxafvjgjxzhpxwyyujfmffaiuvedsmmznszdymuswcwuzttngbzbmbkwmeoz
gdudcprwpzssgofrtdjuvwakicxlqtamykjvyyldfpxksbpadziwbhahakduvevnrqbojcbjbytcntmmgmviqjgfulsc
mxinfektdfljuqaqagfaaludbmbptbeqefxhlwzphtchnphnonnfculdvrcoenkjeeoodcbjhquphnxocrwstphbilsou
kqlcoblrviyjbvywgpmytjstqbmeyeldnccgxjsnsquqbpdzefilynhvujrqtwokeliwoprkbqghqdlejadmjerzjpyomw
ogyrljduymguitzxwpxvbsqctfjbbqmdenosykuqikckcfzcswhlqlotyhxjkyzvuctgylkeobvpcxeagjulpeaaxzxusk
qtewvapmitbrrexbuycawshepyhnlkfdgerjwardexjytzyfwffhhdqigammaaiscpkqtqxnvhvznpnhiviogzwcxgnl
vnyoyfdktlfijdcepzmooprgzhuturwqwgopptvscokbbukqqsdayvqwbuaahskahdqylfrnexkemrkdelvftmvnxixi
pfxwfgfnihxlpqtputjufukhcvcguzwuziatarilkqghvtndossyjjzorwgpfxvdgznylricjzqbudswvndnmpseooacj
afnhbwpmbbskcuejhlnptgzyfqrsgewnzkgkqawxfygrpkltvqnbvmrobivznbnqcyhlyrjrvazrlduanhosgoktwfpe
glaowyizzrlywzdkdbtrlmgkaijxtfbltbsklvvefeqepjqmawskdpczwmrsrxhnjcncgzpirkqajbmeghcntzhwmjebip
hemefmxjvxxrqahxficaliezrivxztotuiyojtbromdkhsfzevzhykbwwequyqaztltogrgwcezezbboxobyxxznxrwfsf
jklkmylmovgtyskhccyrfvkoisqxaskocygsgsfvlgrjomjkaotqyfvincjcolmgrjustosxilxvgmksecglviriediu
csnenwbbchudqkbpwcuizqzwutttaxzinlsatnyxqhpzvdppjfnqpvsgcymxajgdwjaabiirgogvndthrrdmrnxsxshfhd
krhyorqauxiranmdinnubdkilrffmaovvsvqputxrhukomnhwygznbavohhbmljrslqlfewpvcvpjhgfdxeobyumbih"
);
l1d.A('a', 'f', 46); l1d.A('p', 'b', 29); l1d.B('y', 37, 1); l1d.B('z', 8, 1); l1d.A('z', 'v', 32); l1d.A('g',
, 'd', 19); l1d.B('f', 42, 1); l1d.A('o', 'i', 37); l1d.B('d', 43, 1); l1d.A('a', 'u', 36); l1d.A('t', 'j', 23)
; l1d.A('x', 'm', 17); l1d.A('n', 'y', 35); l1d.A('w', 'k', 39); l1d.B('y', 5, 1); l1d.A('q', 'w', 24); l1d.B(
'v', 25, 1); l1d.B('v', 19, 1); l1d.B('v', 39, 1); l1d.B('l', 40, 1); l1d.A('h', 'l', 4); l1d.A('q', 'h', 11); l
ld.A('w', 'k', 37); l1d.A('m', 'k', 30); l1d.A('r', 'x', 31); l1d.A('r', 's', 6); l1d.A('n', 'k', 15); l1d.B(
'i', 7, 1); l1d.A('p', 'q', 6); l1d.B('o', 7, 1); l1d.A('d', 'j', 32); l1d.B('p', 5, 1); l1d.A('a', 'w', 46); l1
d.A('f', 'n', 23); l1d.B('z', 10, 1); l1d.A('v', 'w', 38); l1d.A('r', 'a', 24); l1d.A('n', 'l', 41); l1d.A('c
', 'w', 48); l1d.B('d', 45, 1); l1d.A('d', 'z', 49); l1d.A('i', 'm', 31); l1d.B('c', 8, 1); l1d.A('o', 'm', 24)
; l1d.B('g', 20, 1); l1d.A('p', 'e', 5); l1d.A('c', 'u', 27); l1d.A('t', 'y', 30); l1d.B('y', 6, 2); l1d.A('j'
, 'l', 14);
System.out.println(l1d);
```

HINT: Your answer will start with vveeuuiigg and end with uummbbiiah

CHALLENGE 4

C();

- This method will reduce the size of linked list by half by doing max pooling with size of 2 and stride of 2. Size of 2 means we take the max of 2 characters. Stride of 2 means we take 2 steps at a time.
- Definition of mean:
 - Max of a, a \Rightarrow a
 - Max of a, b \Rightarrow b
 - Max of c, a \Rightarrow c
- If the length of sequence is odd, the last character stays the same.
 - Eg: ['a', 'a', 'a', 'b', 'c', 'z', 'e', 'c'] \Rightarrow C() \Rightarrow ['a', 'b', 'z', 'e'] # Case 1: even
 - Eg: ['a', 'a', 'a', 'b', 'c', 'z', 'e', 'c', 'z'] \Rightarrow C() \Rightarrow ['a', 'b', 'z', 'e', 'z'] # Case 2: odd
- Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("nxzixcybhpstbyyhbmnfjljxapicwouxlvhngfigluxakwaqslpygddybkinosemndelfaolcengxpp
ozsxaqnyuvedeqgyxqsnalggibajoydpnpevkqxuyswerxztldzmhuqkgvzhxstlorwqlpztirtqscvzobcxxxvefuqpui
qafjgkqwduljgsvuokuqjgfirpkznnkffradlxnuesqsddhpkiazdjxylgydnmwwybgyecicmcvejpssbevhslqwomwv
bafjluhfbnxorbgprqaunkrgzhbchgkdgetnukltbreycyhfzsjnoxwsfilcuffmzkogtycgxpdrvqerijyzbqwhfcrogd
yfrlwlssypisuvrlpevojjtjezciltgdghdpzeoscwyckmdwismurtvaxbniajlyvsgdmaypbmyjrzrachnbgjcxabpmd
xrbqcvyoeodxpbdqeuuluhiafvfxlmebeuftohfkhncsbjvitxdhcmllunvzmejfedbfjdnphlvkszgghwwjiawqlwswig
ojkdloyofmrwzzepiofabktsjpizlccpybhaxnouydfiwiwscbmronjyljzpqvdeirwjjzgofrzstqxyqkcxblmaqgbio
npgxdyryqnkjxvicrphrbsoafodfveeyoymfjlyahengerizjwanlyveezijsaudsscpogzvbpdknaxablelrzyavbeclx
knviicsicetmnizodcvxatjffjsdoqxsexktwhntcarzlddjxwdfpqtcohrzmzlrirtuagpexfypunbkyvdlzbfmipxs
ilrabdqvufvqcbofthajpdwlmqumkpxmqluezdiatopdymrbmusnjwiqngnjoadgcwomydcxaujrtlavukjssoknpwkc
rkfzvujjopegymwrlshzveeshtaqvgnisayazuwmumknzclmkkzcofxgdsfpncfmbewhgyhfqbiiqoywxypgrgvnwzhq
voivqrarfjwbjpkmgflkmzteagsyufzssxsiocclewssxhelxcbfncslbxrtqrfwfpgpfuivbqzxqmmzhuekxfjfbcti
ehejoqncqarhrwtdxtafathsytknkuxxvasifiioptankpcccjahkvowtckbbervhmtyzhmrjjgkxgijyhlxoxnywfu
sptennbtvddtlaqtguzimfsjivbbxtgrzesaeuddacxsqtdsjieeoawybygniyqhygcuzvekzmzvogykbbkotqnpftnhk
mmuwolyvhyswccpbyowuftamltzrxtuzvjxqcquiugwnvnshghiojnhmxtaplxacmghnnwscnvhfuxghkakhwjwajklm
wxjariipmaubwcgunxnsertarlpilgmgrufchbnqkqygpqpphzgkvaefduvmgjjwksfztbbnyuvhvpgrkmmllgnkejdz
xiphzhywswobxempliixmfqddzmplnhdpryegfzvrwxrjggwrujranwnnwhtwhslzagcmgytecuwremmqtsitrzsssg
dwdqgiphrrpbbidyytxpvxbadhdzdfcciqdvntnfbopjrvjvowdbfymptuaavhoddkihbwtjgdixnihvlxvtnfzgtgdyvo
kweopytldvdkguhfwjdmhpgavhwnazdlftqkmrajjafobflbywrptnupdrickqktxbquflukvomwmamopgghkvvesqiwrc
uhldcmvqvwbxjatzrsrferfshmdoafokreuxzehpcxhokktqamozqbvggqctwjeekmeigvirttlbaldqgxudfjksrtzejj
yjjvqvebfrkjlbknoxkingtztjtjsqgypndzalcolitpzakjzyubdjwunvtmzqomkghmvltpiomkxohjbkxwyegbzfmropg
qtimcmdtclutuberewcoriruoelvcrnludccucpqnltgnssygzbdhhekipiqiuhpzserfmmoyppzyvhzyfoxbrqruglkob
uptfuifskrbegsgkzmqcwjlqsyv");
l1d.A('t','s',18);l1d.C();l1d.A('g','t',26);l1d.A('u','u',41);l1d.A('s','x',8);l1d.C();l1d.A('
z','z',11);l1d.A('p','v',3);l1d.A('y','d',9);l1d.A('z','o',8);l1d.A('a','h',16);l1d.A('r','k',
4);l1d.A('n','f',5);l1d.A('a','h',21);l1d.A('h','d',16);l1d.A('h','z',4);l1d.A('d','i',12);l1d
.B('n',12,1);l1d.C();l1d.A('g','j',7);
System.out.println(l1d);
```

HINT: Your answer will start with zzyyxxxxvv and end with xxuuuuzzyy

END OF QUESTION PAPER