

## 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/>

### 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 separated by a dot (`.`)
- For example, `'a' -> 'b' -> 'c'` will print out `a.b.c`

Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("bwoaeomkvhbhygcgzcomhdtfwkermiaiahavxlrkcsxlveyugxtmejpouormzrsoiumomhtczeihailvt
rqiwfonaudbisppjhiobesjhyzipdcjcwxyvrakvnwvwjzajpzfwairbshydklhemqwbvvdktjelvylibjaooatdibnfuw
ozlkaeudgbfbondkyrrjtjrchksvnzbyblxebasyacmhstwuvggikiqsggtwojndfawnawfjazlcvxtaufkfpwzumdfqzgb
xcyoijbdovrjzxhazhwmdwzycxxmwcqxrpmxnpvrlflwyjxdchxmeeboewndsttkqhbrskglwwucuevjykgkhkvqybkvff
lawzzqrzujqlqhmezcikyculxqqpqivcapnhtseauqctujqtjgopaswlytk sdfjokohfrzqjpxypifiltvitglqlafrkfo
jakpuebanpnunxzwcpvmosvcrllqsmcpcjdnfwvqintioojhvlhtlljyzsmmpncabyixprutekfngofobnraqcqlidsacqb
lrrndmsxudceshurgktayswgeiuvogzdxydkuyyohxeutxtpojxbjieaogkhfqaehumsreibiwweqimalyzksqtrlwmmx
grxusdylqxfkogzihicftdeerpqvrxtppzmzhulykmlhostutrvtxdenaprokanfnugwzyqcznpgwscggjqidgfgzteixu
yupzaomsdgdpgbwvwwkuacawrwinzuzxtkpruaisqhoxwffmwzwegkqcjtpocejrgyudvnbhngyghiupliygdtcmulwki
gsamuyrbhbhmtomvjdqusopqgvypvfqjgjdvtteyvdyflxjpmzfcptfpmucvqecsyygqxsnszptnaqwoxdmbzjaevysxpcg
xmnekhvufqfnwgnudvprqbgqlgqedmkorgrgdsthhusmxoajctzkmgzksfkbpxmxysfjrlmfqhitbeaxyzqqcgukunlza
mebffymdhutetveosobciisytipfwwwkaibshklpimfrplhkdvvgvcnsinnnznvcvjnnndocvmhnbbrlnzygzrxduebyu
vkrxnlnmbgdjxjrncsbajbezvralfzfdwohsqgphkvgtietkjakpcxnujfsnrwhgtizhielgbjvdkbspfoljxyorprppxcd
cjdttxmlpypylrxsfessfbyujiilzmhsqehbmehjaycejkgdnwlmsldkdwpmvzhvnozrfjnxcjxedrlfwdmfeicbgqgbap"
);
System.out.println(l1d);
```

HINT: Your answer will start with `b.w.o.a.e.` and end with `q.g.b.a.p`

## CHALLENGE 2

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

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

CODE:

```
lld = new LinkedListDecoder();
lld.addString("mvdokrirkezwulsdnnepzscianfybdhzahtcwgxptlnwvnfavkznmmsuhdydmujelcwhvlltfzxaws
zhglpomgywkhxeynyglbbmbjhltkjgeavkjgevhkbcmrjpwzurbzhjcfygtgncyuwemdxtlodhcnmoebylsgypurbudec
ynlnpvetjpsvsuvxbsuzorocxrllzguxcbcyegxtlmwweukauzxdsejgaputsidcokyocwujkihaxftseecqcssojfetlg
ntqqzulxedkganxwrfetcuzawzfdlqwnwzkdqwdphgrpeezjlccxaqbfgcibyotzoyjzuiiilnzraafqbggyugfdpqwkpa
qvhqrlfwbqbpvbrxenaajiqzjghtcybpnzfulgdqfonridrpgpvpbktgfmddmnmxpjkrwhdrvdlgbugumgqaailqb
koigcnkjtjyoxfinctwsecmitpubcwxelbnltftrhcnvutgxrsfifduxzeyyedqnswhklyrnsfabkaixopoqqkguynzpf
xyxymtrhlogqyibagtbmwhsvtdlloavyczwihtdsopqvdrikwssudophbtaugmmlovxrvonnttfedsnjswywjyoyhuq
mohjvlnqtnorylesrzzrbfjqxqfomnuhqnbjpfvrpsbpujjksjecijxhbdicybysiwzwegggcgdprmrbsaxwlmofog
ypmzwgxawqrvjhakqisouzhhsamzudfwaunrzqozuxvxzfpbpvikanssvyczwnscazyndcygdurutgdhxsveacnfbeauyj
ezscjwvrbjqkxoomenrwpejzboetjsfiprhmtyyhmlhyqgdleagrkvqsahgvqitbxtlprmnvbumikwurmekohykggxmpe
hhzpsjskkmemstqjxacdngnbfioptmkkzxbdztjxhyzalyxjsxcjcimizikrsexmperhpjblgmojnrioqevkxlsaydp
dkwilftkxbrvwcfklqiafdvallktjtitikchoiipkfmczajkuddcolzafgxyhvtenrashfvbicgqppiaftrphjypevlmia
sljbgunhaomohjodgffoufzfoukvutbjvxpwvmvubdxvqvubhlfqzfundvbjltymzvqusuvltmbfadjjtrpgnjppoxvk
kvenmyheyckwdidhweifiyrctfyextwiemjqnwpvytwaiihaitxfrqssnpqfkoawgulzkmqgzcqzpcxsecisqmgwqchsa"
);
lld.A('t','m',34);lld.A('d','r',28);lld.A('j','s',44);lld.A('v','k',16);lld.A('w','m',26);lld.
A('l','y',44);lld.A('z','d',4);lld.A('d','n',15);lld.A('f','u',46);lld.A('e','y',7);lld.A('w',
'i',35);lld.A('x','k',37);lld.A('a','l',6);lld.A('w','s',50);lld.A('q','r',31);lld.A('t','e',2
);lld.A('n','z',16);lld.A('l','g',11);lld.A('t','j',30);lld.A('m','x',21);lld.A('f','o',41);ll
d.A('o','i',2);lld.A('k','n',39);lld.A('o','p',34);lld.A('x','z',19);lld.A('u','c',45);lld.A('
i','u',32);lld.A('e','w',47);lld.A('l','z',39);lld.A('a','s',13);lld.A('h','q',17);lld.A('v','
b',25);lld.A('f','j',6);lld.A('l','u',3);lld.A('j','w',27);lld.A('v','o',24);lld.A('y','b',46)
;lld.A('t','l',49);lld.A('f','i',1);lld.A('b','c',25);lld.A('r','s',16);lld.A('x','m',22);lld.
A('h','c',49);lld.A('q','g',3);lld.A('x','k',15);lld.A('e','y',32);lld.A('y','h',36);lld.A('d'
,'x',15);lld.A('d','z',24);lld.A('r','c',6);
System.out.println(lld);
```

HINT: Your answer will start with m.v.d.o.k. and end with q.c.h.s.a

## CHALLENGE 3

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

- This method will remove the sequence between (not inclusive) i-th occurrence of character a and j-th occurrence of character b.
- Eg: ['a', 'a', 'a', 'c', 'b', 'c', 'c'] ⇒ B('a', 2, 'c', 3) ⇒ ['a', 'a', 'c']
  - Remove the sequence between the 2nd 'a' and the 3rd 'c'.
  - In this case, i-th occurrence of a is **before** j-th occurrence of b
- Eg: ['a', 'a', 'a', 'c', 'b', 'c', 'c'] ⇒ B('c', 3, 'a', 2) ⇒ ['a', 'a', 'c']
  - Remove the sequence between the 3rd 'c' and the 2nd 'a'.
  - In this case, the i-th occurrence of a is **after** the j-th occurrence of b
- Run the following code and check your answer.

## CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("bbwrsbldvpmgvteszeynvryahwnmyxuuslmiewuuiejzpmdtswyxtwtymbgggnorubwbpbfgttjnpssxpa
ajrxynafoctokemlvsaqrwrddzjmdutqneihaqlzygoikyltfgwnrirzqpjsngcqrzrprcockjzovyrbkkiycwvqypdhxon
hfrfyrwccatvpusgibcnhnlwlrzczqljdxihahiwwswfbynvqnmnssjmbdofhlwegpjmdokmgevupldbkjhwqttxtztqhu
kddqfeeunwboowjbugqwfhwclqekcjbrioaerzlagbhkyxvsdvrpobupnzfywdcnwreongqpczrtczudpyvmvdcpssoys
nynyybngstleakmailfvvrhmzmbasosszsekzlgkzuzhozopuhytnskeejvirtefvwxoaddalkqkjjjoindnsjznqablja
zoaiihwugdnulaemhvmictxagqphrcbqmouxcbvefndhmqjcwlbqqjilijkesjupamxpbnuqozwdcpawplslilylvcmcsx
hqivoyhlaaffkdfcrfrlckgjcldcotgjqvwxyswbjtdjywkddqzssqvzyxfpwgriczxmtlgrbhvfxjhgpjmijazxrjidphco
pgnzsfscdgaazystmrkzzaxfevjuyxsxkmmxqddvfvegfbttnxrjnvommjxrxjxpdqywemhomlmagkjvortjvhhhvkkvfut
vgsslvqgrcbgdwglklnhhtwbxpbzaelzltssnmydykgpekrhfbybtehepeehtoflteotzvpwovakpedgbqvpkbgqfjuusuuk
acdzbmkvjdhpkxktzsemvxipdjwxifvyylcnqkefrdyrjguvoofdlsrpgkayfslbryhspvtukkqcatuyrqnggfjihjmuco
vbxwaopwoglcaaotmbpbjvuzdiepbakpsuqdsnxqbgaigcxiknjszczxgrwdptixjvgakkrgpxqctsmpbwmalfuamqjsgxs
kmwjekbfpeydxixgqmmnfbiarwotaydkfnxqwhofskeqtevxfeofiuxsuvcmrhvhlakqzynzldxgcmhxxhehowibyzcvcly
nhortbjdpwdiuiubqoocrdecctngiyxzhjcruipbipuaouqlrhasahphficzyelihuiguzqzlqujmdigafmdynvbmcre
tyehikvlozzftibxetkwnkriryfyxwigzmkuxffmandghtlzllopmutzuuunngacglehxiejmifrwtdtzmfmufuttxojbgac"
);
l1d.A('q','n',48);l1d.A('f','b',32);l1d.B('a',45,'h',45);l1d.B('z',33,'l',35);l1d.A('d','c',8)
;l1d.A('p','z',8);l1d.A('p','w',45);l1d.A('t','p',44);l1d.A('x','e',4);l1d.A('q','u',7);l1d.A(
'e','b',2);l1d.A('i','w',19);l1d.A('b','w',28);l1d.A('m','b',15);l1d.A('z','f',7);l1d.A('u','n
',47);l1d.A('n','d',16);l1d.B('a',35,'j',34);l1d.A('p','v',5);l1d.A('z','w',30);l1d.B('h',8,'v
',7);l1d.A('y','r',16);l1d.A('n','b',33);l1d.A('e','t',36);l1d.A('d','h',3);l1d.B('f',6,'c',5)
;l1d.B('n',5,'r',7);l1d.B('m',8,'b',6);l1d.A('j','u',27);l1d.A('a','g',19);l1d.A('r','i',22);l
ld.A('i','j',21);l1d.A('j','g',14);l1d.A('q','v',4);l1d.B('r',13,'d',11);l1d.B('p',15,'q',13);
l1d.A('q','w',5);l1d.B('u',13,'i',12);l1d.B('l',13,'b',12);l1d.B('v',12,'l',13);l1d.A('a','e',
16);l1d.A('p','e',10);l1d.A('f','e',5);l1d.A('i','g',6);l1d.A('p','s',13);l1d.A('y','f',5);l1d
.A('c','w',2);l1d.A('o','u',16);l1d.A('i','j',9);l1d.B('r',13,'g',12);
System.out.println(l1d);
```

HINT: Your answer will start with b.b.w.r.s. and end with j.b.g.a.c

## CHALLENGE 4

C();

- This method will reduce the size of linked list by half by doing mean pooling with size of 2 and stride of 2. Size of 2 means we take the mean of 2 characters. Stride of 2 means we take 2 steps at a time.
- Definition of mean:
  - Mean of a, a  $\Rightarrow$  a
  - Mean of a, b  $\Rightarrow$  b # Take the ceiling
  - Mean of a, c  $\Rightarrow$  b
- 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', 'o', 'd'] # Case 1: even
  - Eg: ['a', 'a', 'a', 'b', 'c', 'z', 'e', 'c', 'z']  $\Rightarrow$  C()  $\Rightarrow$  ['a', 'b', 'o', 'd', 'z'] # Case 2: odd
- Run the following code and check your answer.

CODE:

```
l1d = new LinkedListDecoder();
l1d.addString("nfjbxouiasagueqxpfiieiygopuoisyzahnntuguhcxelvtqqplkvdxplrnlnqlgidcvncellqwitciq
vvdceqniqjlpwfpfmlfrqwbaltnfckimbfbkqbpqqiivbpokzmtjgvlktzxohhruftzhnbsmcjoxguhfolnfqtougprkrs
dcgcynzptqcxoafxetrezcsipfbzevjfrpbphcemwtwtxydokkdcnsvqlloqisnvniumliuhvmdrokbhxadlqmbmiywolh
pnadkvlthawncbdeyvpfluseugkwzsjuzdhgwoqiovpzhfzfkzqrhrtigcybgrsmqjngfjqvadpaplfvomefnipjpiypvuh
ohpaxftqwlxbxyuvhxtgdyypjfzcpnsbkrlrtnctgrhznbiuwnucxthbibjsielandgujamkkgjlvymaglayyqedqfkzs
oywvxglolxxatoeydzozqsgiqockssxbezwwjhkzxdmwpjifnkxyueozogjguaidfshnlwytfcxmfgebrhixjaifajvur
qrlxztotlyhmhoerhzhcgajjhptmbdftrulzlvaxwzmvxowjuaxxakrsnzskxtbhtwzjhqlocwbycwnyxvtfkojvqhbnm
yatxssqekgkzikueynpwnixggysshsruqdetawonigwxfpdiqtqyhzdlmncblherlzqcsfjvbnmbpkcvuttgwdnoyhvea
niuionvdwrftthmmveggdpkdqbquoekmaajujueroextabhqwkjvvezxdmngzxcmpijewcoispmynlvrrdliqcaaumgka
tuftgdrbjwaeqzdvnxznfkvksljkoewiazlutupvecvmfzfwqitmxjaepxwgvniemisriyykbgmaiqidfmllyqkiuydyxf
gqpacplayycaihdyicgtlszrvmkjpdipdofxkvoeqodltuwsygnnolbsqjoeffmmbcfysdnrhftukddofkdprmhbrjzslq
qzwzazjfoeuegxtwdstahbdphvmsbagissvykpetcrkicfrtiyrxakerpvksossmbcdehoryzwpvjcchtspelyhngln
xfayjpuwuxwfsuekystmjsvmcirbprwigvthjtsfjkgsbuscknvzbgyxnsacbmugqeaqurvivfrfmwvsumysmirjrdt
bqjvdegcjevhxqmdjshdjmuojoynrqrjfejdrkmvujpyvptygjnzcvoeqpgzzvwazcsfqaojpbwulkkmqfrcgzlriabjep
wnqbmupvwhbbayablkdzhhzgozryjhantcezezufhrxktcmfclwxhuiyuihzbevsqxwhgidcbkfsfjjwzmufvovebs
rgsmdqgxdmwoncauegoycbpuawggayezrxxtotjgryxnmhadanaxkpdrrkdbgrlntlkrxkuvcmqbepqlsnycdxchbjdgio
wmblozlnexbpyufnblwhjxacoymcwllzydmzrfspkexkotvasmuosybzrhpelwzjkwrnbt");
l1d.A('q','c',51);l1d.C();l1d.A('l','x',26);l1d.A('h','e',1);l1d.A('l','e',2);l1d.A('r','l',18
);l1d.A('w','t',14);l1d.A('h','w',7);l1d.A('t','m',26);l1d.A('w','x',18);l1d.A('f','v',15);l1d
.A('r','b',7);l1d.A('w','k',18);l1d.A('c','o',5);l1d.A('d','i',25);l1d.A('n','v',28);l1d.A('d'
,'g',16);l1d.C();l1d.A('f','w',9);l1d.A('t','q',7);l1d.A('o','q',3);l1d.C();l1d.A('y','s',3);l
ld.C();l1d.A('b','m',2);l1d.A('j','b',3);l1d.C();l1d.A('g','p',1);l1d.A('v','b',1);l1d.C();
System.out.println(l1d);
```

HINT: Your answer will start with o.m.o.o.o. and end with n.o.o.n.p

**END OF QUESTION PAPER**