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 = ⅕
2. Complete challenge 2 = ⅖
3. Complete challenge 3 = ⅗
4. Complete challenge 4 = ⅘
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 are not allowed to use any Java built-in data structure and String library.

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(String str);`

- 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:

```
lld = new LinkedListDecoder();
lld.addString("bwoaeomkvhbhycgzcomhdtfwkermaiahavxlrkcsxlveyugxtmejpouormzrsoiumomhtczeihailvtrqi
wfonaudbispjhiobesjhyzipdcjcwyxvrakvnwvwjzajpzfwairbshydklhemqwqbvvdkbtjelvylbjaoootdibnfuwozlkae
udgbfbondkyrrjtjrchksvnzbyblxebsyacmhstwuvggikiqsgqtwojndfawnawfjazlcvxtaufkfpwzumdfqzgbxcyoijbdo
vrjzxhazhwmdwzyrcxxmwcqxrpmxnpvrlflwyjxdchxmeeboewndsttkqhbrskglwwucuevjykghkvqybkvfflawzzqrzujql
qhmezcikyculxqqpqivcapnhtseauqctujqtjgopaswlytksdfjokohfrzqjpxypifiltvitglqlafrkfojakpuebanpnunxz
wcpvmosvcrlqsmpcjdnfwvqintioojhvlhtlljyzsmmpncabyixprutekfngofobnraqcqlidsacbqblrtndmsxudceshurgk
tayswgeiuvogzdxydkuyyohxeutxtpojxbjieaogkhfqcaehumsreibiwweqimalyzksqtrlwwmxgrxusdylqxfkogzihicft
deerpqvrxtppzmzhulykmhlostutrvtxdenaprokanfnugwzyqcznpgwscggjqidgfgzteixuyupzaomsdgdpgbwvwkuacawr
winzuzxtkpruaisqhoxwffmwzwzegkqcjtpocejrgyudvnbnhgyghiupliygdtcmuluwkigsamuyrbbhmtomvjdqusopqgvyp
vfqjgjvdbteyvydflxjpmzfcptfpnmucvqecsygqxsnszptnaqwoxdmbzjaevysxpcgxmnekhvufqfnwgnudvprqbqlgqedmk
orgrgdsthhusmxoajctzkmgzksfkbpkxmxyosfjrlmfqhitbeaxyzqqcgukunlzamebffymdhhutetveosobciisyitipfwww
kaibshklpimfrplhkdvvqvcnsinnnzncvjnndocvmhnbbrlnyzygzrxduebyuvkrxnlmbgdxjrncsbajbezvralfzfdwohsqg
phkvgltietkjakpcxnujfsnrwhgtizhielgbjvdkbspfoljxyorprppxcdcjdttxmlypyylraxfessfbyujiilzmhsqehbmeh
jaycejkgdnwlmsldkdwpnvhzvnozrfjnxcjxedrlfwdmfeicbqgbap");
System.out.println(lld);
```

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("mvdokrirkezrwulsdnnepzsclanfybdhzahtcwgxptlnwvnfavkznmmsuhdydmujelcwhvlltfzxawszhg
lpomgywkhxeynyglbbmbjhltkjgeavkjqevhkbcmrjpwzurbzhjcfytgncyuwemdxotlodhcnmoebyilsgypurbudecynlnpv
etjpsvsuvxbsuzorocxrrlzguxcbcyegxtlmwweukauzxdsejqaputsidcokyocwujkihxaxftseecqcsojfetlgntqquzlxe
dkganxwrfetcuzawzfdlqwknwzkdqwdphgrpeezjlccxaqbfgcibyotzoyjzuiiilnzraafqbgyugfdpqwkpaqvhqrlfwbqbp
vbrrxenaojiqzjghtcybpnzfulgdqfonridrpgpvpbktgfmdqvddmnxmpjkrwhdrvdlgbugumgqaaiilqbkoigcnkjtyoxfin
ctwsecmitpubcwxelbnltffrhcnvutgxrwsfifduxzeyyxedqnshwklyrnsfabkaixopoqkqguynzpfxyxmymtrhlogqyibag
tbmwhsvtdllooavycczwihtdsopqvdrikwwssudophbtaugmmlovxrvonnttfedsnjswywjoyhuqmohjvlwnqtnorylesrzrz
bfqjxqfomnuhqnbjpfvrxpsbpujjksjecijxhbdicybymsiwzweggqcgdprmrbnsaxwlmofogypmzwgxawqrvjhakqisouzhh
samzudfwaunrzqozuxvxzfpbpvikanssvyczwnscazyndcygdurutgdhxsveacnfbeauyjezscjwvrbjqkxoomenrwpejzboe
tjsfiprhmtyyhmlhyqgdleaegrkvsqahgvqitbxltprmnvbumikwurmekohykkgxmpahhzpsjskkmemstqjaxcdgngbfiopbc
ptmkkzhbdztjxhyzalyxjsxcjcimizikrsexmperhpjblgmojnrioqevkxlsaydpdkwilftkxbrvwvcflkqiafdvallktjtit
ikchoiipkfmcazjkuddcolzafgxyhvtenrashfvbicgqpiaftrphjypevlmiasljbgunhaomohjodgffoufzfoukvutbjvxpw
vmvubdxvqvuqbhlfdqzfundvbjltymzvqusuvltmbfadjjtrpgnjjpoxvkkvenmyheyckwdidhweifiyrcrfyextwiemjqnwp
vytwaiihaitxfrqssnpoqfkoawgulzkmgzcqzpcxsecisqmgwqchsa");
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);lld.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);ll
d.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:

```
lld = new LinkedListDecoder();
lld.addString("bbwrsbldvpmgvteszeynvryahwnmyxuuslmiewuuiejzpmdtswyxtwtybggnorubwpbfgttjnpssxpaajr
xynafocntokemlvsaqrwrdzjmduotqneihaqlzygoikyltfgwnrirzqpjsngcqrzrpcockjzovyrbkiycwvqypdhxonhfrfyr
wccatvpusgibcnhnblwlrczqljdxihahiwwswfbynvqnmnssjmbdoufhlwegpjmdokmgevupldbkjhwqttxztqhukddqfeeun
wboowjbugqwfhwclqekcjbrioaeerzlagbhkyxvsdvrpobupnzfywdcnwreonqgpczrtczudpyvfmvdcpsoysnynyybngstle
akmailfvvrhmzbmasosszsekzlgekzuhozopuhytnskeejvirtefvwqxoaddalkqkjjoindnsjznqabljazoaiihwugdnulae
mhvmictxagqphrcbqmouxcbvefndhmqjcwlbqqjilijkesjupamxpbnuqozwdcpawplsliylvlcmscxhqivoyhlaffkdfcrfr
lckgjclcotgjwqvwxyswbjtjdywkdqzssqvzyxfpwqriczxmtlgrbhvfxjhgpjmijazxrjidphcopgnzsfscdqaazystmrkzz
axfevjuyxsxkmmxqddvfvegfbtnnxrjnvommjxrjxpdqywmehomlmagkjvortjvhhhvkkvfutvgsslvqgrcbgdwgklnhhwtbx
pbzaelzltssnmydykgpekrhfybtehpeeehtoflteotzvpwowakpedgbqvpkbgqfjuusuukacdzbmkvjdhpkxktzsemvxipdjw
xifvyylcnqkefrdyrjguvoofdlsrpgkayfslbryhspvtukkqcatuyrqnqgfyihjmucovbxwaopwoglcaaotmbpjbvuzdiepba
kpsuqdsnxbqaigcxiknjscizxgrwdptixjvgakkrpgxqctsmpbwmalfuamqjsgxskmwjekbfpeydxixgqmnnfbiarwotaydkf
nxqwhofskeqtevxfeofiuxsuvcmrhvlakqzynzldxgcmhxhxehowibyzcvclynhortbjdpwdiuiubqoocrdecctngiyxzhjcr
uipbipuaouqlrhsahphficzzyelihluiguzqzlqujmdigaftmdynvbmcretyehikvlozzftibxetkwnkrryfyxwigzmkuxffm
andghtlzilopmutzuuunngacglehxiejmifrwdtzfmfufttxojbgac");
lld.A('q','n',48);lld.A('f','b',32);lld.B('a',45,'h',45);lld.B('z',33,'l',35);lld.A('d','c',8);ll
d.A('p','z',8);lld.A('p','w',45);lld.A('t','p',44);lld.A('x','e',4);lld.A('q','u',7);lld.A('e','b
',2);lld.A('i','w',19);lld.A('b','w',28);lld.A('m','b',15);lld.A('z','f',7);lld.A('u','n',47);lld
.A('n','d',16);lld.B('a',35,'j',34);lld.A('p','v',5);lld.A('z','w',30);lld.B('h',8,'v',7);lld.A('
y','r',16);lld.A('n','b',33);lld.A('e','t',36);lld.A('d','h',3);lld.B('f',6,'c',5);lld.B('n',5,'r
',7);lld.B('m',8,'b',6);lld.A('j','u',27);lld.A('a','g',19);lld.A('r','i',22);lld.A('i','j',21);l
ld.A('j','g',14);lld.A('q','v',4);lld.B('r',13,'d',11);lld.B('p',15,'q',13);lld.A('q','w',5);lld.
B('u',13,'i',12);lld.B('l',13,'b',12);lld.B('v',12,'l',13);lld.A('a','e',16);lld.A('p','e',10);ll
d.A('f','e',5);lld.A('i','g',6);lld.A('p','s',13);lld.A('y','f',5);lld.A('c','w',2);lld.A('o','u'
,16);lld.A('i','j',9);lld.B('r',13,'g',12);
System.out.println(lld);
```

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 ⇒ a
  - Mean of a, b ⇒ b # Take the ceiling
  - Mean of a, c ⇒ b
- If the length of sequence is odd, the last character stays the same.
  - Eg: [‘a’, ‘a’, ‘a’, ‘b’, ‘c’, ‘z’, ‘e’, ‘c’] ⇒ C() ⇒ [‘a’, ‘b’, ‘o’, ‘d’] # Case 1: even
  - Eg: [‘a’, ‘a’, ‘a’, ‘b’, ‘c’, ‘z’, ‘e’, ‘c’, ‘z’] ⇒ C() ⇒ [‘a’, ‘b’, ‘o’, ‘d’, ‘z’] # Case 2: odd
- Run the following code and check your answer.

CODE:

```
lld = new LinkedListDecoder();
lld.addString("nfjbxouiasagueqxpfieeiygopuoisyzahnntuguhcxelvtqqplkvdxplrnlnqlgidcvncllqwitciqvvd
ceqniqjlpwfzpfmlfrqwbaltnfckimbfkqbppqiivbpokzmtjgvlktzxohhruftzhnbsmcjoxguhfolnfqtougprkrsdcgcyn
zptqcxoafxetrezcsipfbzevjfrpbphcemwtwtxydokkdcsnvqlloqisnvniumliuhvmdrokbhxadlqmbmiywolhpnadkvlta
hwncbdeyvpfluseugkwzsjuzdhgwoqiovuphzfkzqrhrtigcybgrsmqjngfjqvadpaplfvomefnipjpiypvuhohpaxftqvwlb
xyuvhxtgdyypjfzcpsnbklrtnctrghzdnbiuwcnucxthbibjsielandgujamkkgjlvymaglayyqedqfkzsoywvxglolxxatoe
ydzozqsgiqockssxbezzwwjhkzxdmwpjifnkyxueozogjguaidfshnlwytfcxmfgebrhixjaifajvurqrlxztotlyhmhoerhz
hcgajjhptmbdftrulzlvaxwzmvxowjuaxxakrsnzskxtbhtrwzjhqlocwbycwnyxvtfkojvqhbnmyatxssqekgkzikueynpwn
ixgqysshsruqdctawonigwxfpdiftqyhzdlmncblherlzqcsfjvbndmbpkcvuttgwdnoyhveaniuionvdwrfthmmveqgdpkdq
bquoekmaajujuroextabhqwkjjvezxdmxngzxcmpijewcoispmyognlvrrdliqcaaumgkatuftgdrbjwaeqzdvnxznfkvkslj
koewiazlutupvecvfmzfwhqitmxjaepxwgvniemisriyykbgmaiqidfmlyqkiuydyxfgqpacplayycaihdyicgtlszrvmkjpd
ipdofxkvoeqodltuwsgybnnolbsqjoefmmbcfsydnrhftukddofkdprmhrbjzslqqzwzazjfoeuegxwtdwstahbdphvmsbagi
ssvykpetcrkicfrtiyrxakerpvksossmcbcdehyorzwkpvjcchtspelyhnglnxfayjpuwuxwfsuekystmjsvmcirbprwigvtt
hjtsfjkgsbuscknvzbgynxsacbwmugqeaqurvifwrfmvwpsumysmirjrdtbqjvdegcjevhxqmdjshdjmuojynrqrjfejdrkmv
ujpyvptygjnczvoeqpgzzvwwazcsfqaojpbwulkkmqfrcgzlriabjepwnqbmutpvwhbbaeyablkduzhzgozryhjhantcezefu
hrxktcmfcrlwxhuiyuihzbevsqxwhgidcbkfsfjjwzmuwfovyebsrgsomdqgxdmwoncauegoycbpuawggayezxrxotjgryxnm
hadanaxkpdrkbdgrlngtlkrxkuvcmqbepqlsnycdxchbjdgiowmblozlneexbpyufnblwhjxacoymcwwlzydmzrfspkexkotv
asmuosybzrhpelwzjkwrnbt");
lld.A('q','c',51);lld.C();lld.A('l','x',26);lld.A('h','e',1);lld.A('l','e',2);lld.A('r','l',18);l
ld.A('w','t',14);lld.A('h','w',7);lld.A('t','m',26);lld.A('w','x',18);lld.A('f','v',15);lld.A('r'
,'b',7);lld.A('w','k',18);lld.A('c','o',5);lld.A('d','i',25);lld.A('n','v',28);lld.A('d','g',16);
lld.C();lld.A('f','w',9);lld.A('t','q',7);lld.A('o','q',3);lld.C();lld.A('y','s',3);lld.C();lld.A
('b','m',2);lld.A('j','b',3);lld.C();lld.A('g','p',1);lld.A('v','b',1);lld.C();
System.out.println(lld);
```

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

END OF QUESTION PAPER