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2. Spark Programming (75 points)

In these exercises we will practice Spark programming with special emphasis on data parallel processing. Exercises from 2.1 to 2.5 can be tried locally, 2.6 requires a EMR AWS cluster.

2.1. Distributed Grep (10 points)

Develop a Spark version of the grep tool to search words in very large documents. The output should be the lines that match a given pattern. You can use as input file the input text used in the word count example described in class (eBook of Moby Dick).

```
$ spark-submit P21_spark.py word
```

Submission

- P21_spark.py: Spark script
- P21.pdf: The command line that you used to execute the job and any information required to reproduce the execution

Command Used:

```
spark-submit P21_spark.py word
```

Output:

```
the word, you deliver that which is not true." --HACKLUYT
"In that day, the Lord with his sore, and great, and strong sword,
    With swords, saws, spiral horns, or hooked fangs."
philosophical flourish Cato throws himself upon his sword; I quietly
on, from the bright red windows of the "Sword-Fish Inn," there came
such
Crossed Harpoons," and "The Sword-Fish?"--this, then must needs be
the
a tall straight jet of misty spray, and these words underneath--"The
head-peddler. But I lay perfectly still, and resolved not to say a
word
so significant and infidel a word, and yet do not thus entitle him,
if
Yes, for replenished with the meat and wine of the word, to the
faithful
While he was speaking these words, the howling of the shrieking,
words:
earth; and 'vomited out Jonah upon the dry land;' when the word of
the
words, yet subsequent disclosures, when I had become more familiar
with
but the word "clam," Mrs. Hussey hurried towards an open door
leading to
a little experiment. Stepping to the kitchen door, I uttered the
word
galliot, and what not; but take my word for it, you never saw such
a
But all we said, not a word could we drag out of him; I almost felt
nor say a single word, nor even look at me, nor notice my presence
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in
word did he reply.
such melancholy notions about their hereafters. In one word,
Queequeg,
Without saying a word, Queequeg, in his wild sort of way, jumped
upon
the above words were put to us by a stranger, who, pausing before
us,
upon the word HE.
he gives an order. Step and growl; growl and go--that's the word
with
according to the prophecy. Didn't ye hear a word about them matters
and
On the day following Queequeg's signing the articles, word was given
at
Jury." And with these cracked words he finally departed, leaving me,
for
"No need of profane words, however great the hurry, Peleg," said
Bildad,
Never did those sweet words sound more sweetly to me than then. They
cabin to speak another farewell word there; again came on deck, and
a word below, and now a word with Starbuck, the chief mate.
Alfred the Great, who, with his own royal pen, took down the words
from
see what that word "careful" precisely means when used by a man like
forward dedication of that glance. Not a word he spoke; nor did his
the word literally expresses. In those times, also, spermaceti was
say. It does not seem to be used like the blade of the sword-fish
and
feet should be marshalled among WHALES--a word, which, in the
popular
kept my word. But I now leave my cetological System standing thus
officer called the Specksynder. Literally this word means Fat-
Cutter;
to heighten its lustre, and without using any words was meanwhile
him--him--" faltering hard for a word, and screwing his hand round
and
unsays itself. There are men from whom warm words are small
indignity. I
I say; merry's the word; hurrah! Damn me, won't you dance? Form,
now,
by for reefing, hearties! the winds are just crossing swords, pell-
mell
the Latin word for white, all Christian priests derive the name of
words above.
He substantiates every word. The ship, however, was by no means a
large
Queequeg and I were mildly employed weaving what is called a sword-
mat,
Queequeg, standing sideways, ever and anon slid his heavy oaken
sword
the intermitting dull sound of the sword, that it seemed as if this
were
indifferent sword, sometimes hitting the woof slantingly, or
crookedly,
aspect of the completed fabric; this savage's sword, thought I,
easy, indifferent sword must be chance--aye, chance, free will, and
"Mr. Starbuck! larboard boat there, ahoy! a word with ye, sir, if ye

yes, give him fits--that's the very word--pitch fits into 'em.
Merrily,
merrily, hearts-alive. Pudding for supper, you know;--merry's the
word.
his--these were words best omitted here; for you live under the
blessed
seas may give ear to such words, when, with tornado brow, and eyes
of
he swung as in a loosened belt. Few or no words were spoken; and the
wordless Ahab stood up to the blast. Even when wearied nature seemed
fishermen, mildly eyeing us as they passed, said not one word to our
own
There seemed but little in the words, but the tone conveyed more of
deep
oftentimes pass on without so much as a single word of recognition,
down the columns of dictionaries, and never find the word. Dr.
Johnson
Nevertheless, this same expressive word has now for many years been
in
common. They supposed a sword-fish had stabbed her, gentlemen. But
the
his part of the hull and tow it home. The fact is, boys, that sword-
fish
yourself; say the word; don't be a fool; forget it all; we are ready
you say the word about not flogging us, we don't do a hand's turn.'
no more, made good his word, spite of Steerkilt's threat, whatever
that
the line, at the word of command. Moreover, when the four boats were
retreat from Nantucket. In a word, Frederick Cuvier's Sperm Whale is
not
France; where every sword seems a flash of the Northern Lights, and
the
her, all; but keep cool, keep cool--cucumbers is the word--easy,
sharp two-edged sword by the blade, and that enemy all the time
striving
flying fish; at the word of command, the boat alternately sterning
A word concerning an incident in the last chapter.
along, and in obedience to the word of command, came to a dead stop
on
"Cook," here interposed Stubb, accompanying the word with a sudden
slap
oder, Massa Stubb; dey don't hear one word; no use a-preaching to
mouthful at the last word, so that morsel seemed a continuation of
the
called a boarding-sword, and watching his chance he dexterously
slices
follows. Whereupon, this accomplished swordsman, warning all hands
to
hieroglyphics, then that is the proper word to use in the present
A word or two more concerning this matter of the skin or blubber of
than he can one exactly astern. In a word, the position of the
whale's
behind. In a word, you would have two backs, so to speak; but, at
the
we now slide into the mouth. Upon my word were I at Mackinaw, I
should
till it entirely disappears; then giving the word to the seamen at
the

with a boarding-sword in his hand, was for one swift moment seen the slowly descending head, Queequeg with his keen sword had made dropping his sword, had thrust his long arm far inwards and upwards, or his head with fish-spears? The sword of him that layeth at him cannot in truth, some versions of the Bible use that word itself. Besides, it sword, or broad sword, in all its exercises boasts nothing like it. It shall err; though I may possibly use some superfluous scientific words. gas-pipe is also a water-pipe; in other words, whether the spout of the and the wind now dying away, word was passed to spring to the boats. But themselves sometimes consist in hard words and harder knocks--the In a word, the whale was seized and sold, and his Grace the Duke of the word ROSE, and the bulbous figure-head put together, sufficiently "Oh! keep cool--cool? yes, that's the word! why don't you pack those to the learned. Though the word ambergris is but the French compound for Alas! Stubb was but too true to his word. It was a beautiful, bounteous, Nippers. Strictly this word is not indigenous to the whale's vocabulary. ignition to the staple fuel. In a word, after being tried out, the their unholy adventures, their tales of terror told in words of mirth; bare words and facts, but we come in to supply the thoughts. That's my so, alow here, does jolly Stubb. Oh, jolly's the word for aye! Adieu, word, held himself fast, and at the same time also helped to hoist his ivory leg, and crossing the ivory arm (like two sword-fish blades) sword that so affrighted Damocles. verdure. Oh, busy weaver! unseen weaver!--pause!--one word!--whither toilings? Speak, weaver!--stay thy hand!--but one single word with it. For even so it is in all material factories. The spoken words that are inaudible among the flying spindles; those same words are plainly words of the dictionary. And here be it said, that whenever it has been he's queer; says nothing but that one sufficient little word queer; he's fearful in man, never yet was put into words or books. And the drawing his own sovereign will and pleasure. He answered, certainly. In a word, To sailors, oaths are household words; they will swear in the trance of While this pallidness was burning aloft, few words were heard from the so at those last words of Ahab's many of the mariners did run from him prolongingly moulded every word--"Captain Gardiner, I will not do

it.
they seemed pole-like asunder. If by day they chanced to speak one word;
he gave the word for them to hoist him to his perch, Starbuck being mighty leviathans, sword-fish, and sharks; and these were the strong,
"MY line! MY line? Gone?—gone? What means that little word?—What
He gave the word; and still gazing round him, was steadily lowered thy word. Where is the second hearse? Away, mates, to the ship!
those
word processing or hypertext form. However, if you provide access to or