riseset_notebook

April 12, 2023

1 `riseset` Examples

This notebook demonstrates the J riseset script. `riseset` computes the rise, transit, and set times of named IAU Stars.

To run this notebook you must install a J jupyter kernel. See Martin Saurer's GitHub repository for instructions.

[1]:
```
NB. J version and date
smoutput 9!:14 ''
smoutput 6!:0 ''

NB. set portable box drawing characters
portchars=:[: 9!:7 '+++++++++|-'"_ [ ]
portchars 0
```

```
j9.4.2/j64avx512/windows/commercial/www.jsoftware.com/2023-04-10T01:15:50/clang-15-0-7/SLEEF=1
2023 4 12 10 19 6.549
```

1.1 Installation

`riseset` is distributed as a J addon. It is installed in the J `~addons/jacks` folder. It can be installed from GitHub with:

[2]:
```
load 'pacman'
NB. smoutput install 'github:bakerjd99/jackshacks' NB. uncomment to install
```

The `jacks` (J-hacks) addons are self contained JOD generated J scripts. Each `ijs` script is accompanied with `pdf` document that describes how to use it. Some scripts, like `riseset` are also packaged with a Jupyter notebook (this file) and a `pdf` version of the notebook. For example, the `riseset` files are:

```
riseset.ijs
riseset.pdf
riseset_notebook.ipynb
riseset_notebook.pdf
```

There are other scripts in `~addons/jacks` and more will be added from time to time. To refresh the folder, reissue the install command.

In addition to these files the subfolder `~addons/jacks/testdata` contains data files. `riseset` files in `testdata` are:

```
Bright_Stars_Meridian_Almanac_23mar27.md
iau_named_stars_2022.txt
Navigation_Stars.txt
```

[3]:
```
NB. addon files
dir '~addons/jacks'
```

```
testdata                 <dir>     06-Apr-23 13:20:13
brandxmp.ijs                 13295 28-Mar-23 22:45:21
brandxmp.pdf                125252 28-Mar-23 22:45:21
gpxutils.ijs                 17079 28-Mar-23 22:45:21
gpxutils.pdf                134365 28-Mar-23 22:45:21
ipynb.ijs                    4699 28-Mar-23 22:45:21
ipynb.pdf                   86966 28-Mar-23 22:45:21
manifest.ijs                 1329 08-Apr-23 13:00:01
riseset.ijs                 38243 08-Apr-23 12:56:52
riseset.pdf                193513 08-Apr-23 12:56:52
riseset_notebook.ipynb      28125 06-Apr-23 09:41:38
riseset_notebook.pdf        69512 06-Apr-23 09:41:38
```

1.2 Using `riseset`

[4]:
```
NB. load '~addons/jacks/riseset.ijs'  NB. addon version
load 'riseset' NB. dev version

smoutput 'NB. vmd: ' , ,'0,p<; >q<; >0,0' (8!:2) VMDriseset
```

```
NB. (riseset) interface word(s): 20230408j134518
NB. ----------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

NB. vmd: 0.9.7; 11; 08 Apr 2023 13:45:18
```

[5]:
```
NB. set a location - add your own by cloning and modifying location verbs
location_yellowstone
```

```
3 : 0

NB.*location_yellowstone v-- set parameters for Old Faithful location.
NB.
NB. monad:  location_yellowstone uuIgnore
NB.
NB.   location_yellowstone 0
NB.   NB. uses location with current date
NB.   iau_today 0
NB.
NB. dyad:  bl =. flYmfd location_yellowstone uuIgnore
NB.
NB.   NB. uses location with yellowstone date
NB.   (location_yellowstone 0) iau_today 0
NB.
NB.   NB. arbitrary dates for location
NB.   fmt_today (1712 3 15.34 location_yellowstone 0) nav_today 0
NB.   fmt_today (location_yellowstone~ 1933 9 25.75) iau_today 0

2013 5 7 location_yellowstone y
:
JULIAN_riseset_=: julfrcal ymd=. x

NB. longitude, latitude with standard signs
OBSLOCATION_riseset_=: _110.82792 44.46057
LOCATIONNAME_riseset_=: 'Yellowstone - Old Faithful'

UTCOFFSET_riseset_=: 6.0   NB. MST time zone
LIMITMAG_riseset_=:  6.0   NB. stellar magnitude
LIMITHORZ_riseset_=: 10    NB. degrees above horizon

ymd;JULIAN;OBSLOCATION;UTCOFFSET;LIMITMAG;LIMITHORZ;LOCATIONNAME
)
```

[6]:
```
location_yellowstone 0
'IAU locname cParms'=: iau_today 0

NB. number of rising/setting IAU stars
smoutput #IAU
NB. limit magnitude, above horizon, julian date, ΔT in seconds, longitude,␣
 ↪latitude, year, month day.dd
smoutput locname;cParms
NB. star name, designation, transit altitude degrees, transit time 24 hours␣
 ↪minutes
```

```
smoutput 5 {. IAU
```

```
243
+-------------------------+-------------------------------------------------------
---------------+
|Yellowstone - Old Faithful|6 10 2460046.75 73.45591845312505 _110.82792
44.46057 2023 4 12.25 6|
+-------------------------+-------------------------------------------------------
---------------+
+-------+-------+----+----+
|Alchiba|HR 4623|20.5|0 12|
+-------+-------+----+----+
|Gienah |HR 4662|28  |0 20|
+-------+-------+----+----+
|Zaniah |HR 4689|44.5|0 24|
+-------+-------+----+----+
|Algorab|HR 4757|29  |0 34|
+-------+-------+----+----+
|Chara  |HR 4785|87  |0 37|
+-------+-------+----+----+
```

Detailed rise and set information is provided by `riseset`.

[7]:
```
LB=:  _116.375956 43.646775   NB. Meridian
YMD=: 2023 3 27
UO=:  6                       NB. MST UTC offset

NB. star name, (0=rises/sets), altitudes, times fractional day, times hours,␣
 ↪minutes
'Rs cParms'=: (YMD;UO;LB) riseset 'Algol';'Rigel';'Spica'
smoutput cParms
smoutput Rs
```

```
2460030.75 73.40741357812496 _116.375956 43.646775 2023 3 27.25 6
+-----+-+------------------------------+
|Algol|0| 0.5  0.2910386461449466  6 59|
|     | |87.5  0.6908345293917257 16 35|
|     | | 0.5 0.09337060171945516  2 14|
+-----+-+------------------------------+
|Rigel|0|  1   0.5527905462948185 13 16|
|     | | 38   0.7780712498266437 18 40|
|     | |0.5 0.006088476753742347  0  9|
+-----+-+------------------------------+
|Spica|0|  1  0.9012706582406574 21 38 |
|     | | 35 _0.8793144933635634  2 54 |
|     | |0.5  0.3373585646884121  8  6 |
+-----+-+------------------------------+
```

The stars listed by `riseset` come from IAU named stars.

[8]:
```
NB. leading characters from UTF-8 CSV IAU star data file
800 {. read jpath '~addons/jacks/testdata/iau_named_stars_2022.txt'
```

```
IAU_Name,Designation,HIP,Bayer_Name,Nm,WDS_J,Vmag,RA_J2000,Dec_J2000,Origin,Sou
rce,ID,Const,Etymology_Note
Absolutno,XO-5,XO-5,_ Lyn,_,_,12.13,116.716506,39.094572,2019 IAU100
NameExoWorlds,https://www.nameexoworlds.iau.org/2019approved-names,_,Lyn,Czech
Republic proposal;Absolutno is a fictional miraculous substance in the sci-fi
novel Továrna na absolutno (T…
Acamar,HR 897,13847, 1 Eri,A,02583-4018,2.88,44.565311,-40.304672,,, 1,Eri,
Achernar,HR 472,7588,  Eri,A,-,0.45,24.428523,-57.236753,Arabic,, ,Eri,The name
was originally Arabic:       ʾāẖir an-nahr ('river's end').
Achird,HR 219,3821,  Cas,A,00491+5749,3.46,12.276213,57.815187,,, ,Cas,"first
applied to  Cassiopeiae in the Skalnate Pleso
```

[9]:
```
loadstars~ 2
smoutput 'Named stars:', ":#IAU_Name
smoutput 10 {. IAU_Name
```

```
Named stars:449
+---------+------+--------+------+-----+-----+-------+--------+------+-----+
|Absolutno|Acamar|Achernar|Achird|Acrab|Acrux|Acubens|Adhafera|Adhara|Adhil|
+---------+------+--------+------+-----+-----+-------+--------+------+-----+
```

Additional stars/objects can be added by editing the IAU file or by doing the following.

New objects need a name, right acension (RA), and declination (Dec) for the J2000.0 epoch.

[10]:
```
NB. meeus pg. 99,100
LB=: _71.0833 42.3333  NB. Boston
YMD=: 1988 3 20
UO=: 0
NB. add objects not in IAU names - needs - name, ra, dec
AOB=. (<;:'Venus'),(<41.73129),<18.44092
AOB=. ,&.> (;:'OBJ_Name OBJ_RA_J2000 OBJ_Dec_J2000') ,. AOB
DeltaTsOveride_riseset_=: 56
'Vrs cParms'=: (YMD;UO;LB;<AOB) riseset 'Venus'
0 0$erase 'DeltaTsOveride_riseset_'
smoutput cParms
smoutput Vrs
```

```
2447240.5 56 _71.08329999999999 42.3333 1988 3 20 0
+-----+-+---------------------------+
|Venus|0|  1 0.5211284270665463 12 30|
|     | | 66 0.8169433896164773 19 36|
|     | |0.5 0.1154978057116963  2 46|
+-----+-+---------------------------+
```

1.3 Maintaining and modifying `riseset`

All `riseset` code, documentation and test scripts are stored in the JOD dictionary `futs`. To change the code or run the test cases you need to install the JOD dictionaries `futs` and `utils`.

Use J's package manager to install the JOD addons `general/jod`, `general/joddocument`. If you have installed all the addons JOD is already on your system.

After installing JOD do:

1. Download the JOD dump scripts:

   https://github.com/bakerjd99/joddumps/blob/master/utils.ijs

   https://github.com/bakerjd99/joddumps/blob/master/futs.ijs

   and put them in a `~temp` folder.

2. Start JOD and check for the presence of `futs` and `utils`.

```
NB. start JOD
load 'general/jod'
(;:'futs utils') e. od''
```

3. **Only if both dictionaries are missing do:**

```
newd 'utils'  NB. creates utils dictionary in '~user/joddicts/utils'
newd 'futs'   NB. creates futs in '~user/joddicts/futs'
```

4. Load the dictionares:

```
NB. load utils first
od 'utils' [ 3 od ''
0!:0 <jpath '~temp/utils.ijs'
NB. rebuild references
0 globs&> }. revo ''
NB. take first binary backup
packd 'utils'

NB. load futs with utils on path
od ;:'futs utils' [ 3 od ''
0!:0 <jpath '~temp/futs.ijs'
NB. rebuild references
0 globs&> }. revo ''
NB. take first binary backup
packd 'futs'

NB. close dictionaries
3 od ''
```

The rest of this notebook *assumes* you have installed `futs` and `utils`.

It also assumes a basic knowledge of JOD. See the JOD Manual for details. The JOD Manual is distributed in the `general/joddocument` addon - see:

```
~addons/general/joddocument/pdfdoc/jod.pdf
```

`jod.pdf` is also available on The JOD Page

1.4 `riseset` test suite

Many `riseset` test cases are in `futs`. Groups of test cases are called suites. The contents of the `riseset` suite is:

[11]:
```
NB. open futs and utils - assumed open until notebook end
load 'general/jod'
od ;:'futs utils' [ 3 od ''
```

```
+-+----------------+----+-----+
|1|opened (rw/ro) ->|futs|utils|
+-+----------------+----+-----+
```

[12]:
```
NB. list test cases in (riseset) suite
smoutput ,. }. 3 grp 'riseset'
```

```
+----------------------------+
|riseset_atan2_smoke         |
+----------------------------+
|riseset_espenak_smoke       |
+----------------------------+
|riseset_meeus_smoke         |
+----------------------------+
|riseset_navstars_ecu_smoke  |
+----------------------------+
|riseset_navstars_safari_smoke|
+----------------------------+
|riseset_riseset_smoke       |
+----------------------------+
|riseset_tanner_smoke        |
+----------------------------+
```

[13]:
```
NB. show test case
1 disp 'riseset_riseset_smoke'
```

```
NB.*riseset_riseset_smoke t-- (riseset) smoke tests.
NB.
NB. created: 2023mar27
NB. changes: ------------------------------------------------------
NB. 23apr01 location name added

load 'riseset'

NB. meeus pg. 99,100
```

```
LB=: _71.0833 42.3333  NB. Boston
YMD=: 1988 3 20
UO=: 0
NB. add objects not in IAU names - needs - name, ra, dec
AOB=. (<;:'Venus'),(<41.73129),<18.44092
AOB=. ,&.> (;:'OBJ_Name OBJ_RA_J2000 OBJ_Dec_J2000') ,. AOB
DeltaTsOveride_riseset_=: 56
'Vrs cParms'=: (YMD;UO;LB;<AOB) riseset 'Venus'
0 0$erase 'DeltaTsOveride_riseset_'

NB. values are within 10 minutes of the meeus book
NB. result - not great but good enough for demo work
Meeusmin=:  +/" 1 ] 60 1 *"1 ] 12 25 , 19 41 ,: 2 55
10 > >./|Meeusmin - +/" 1 ] 60 1 *"1 ] _2 {."1 ;2 {"1 Vrs

LB=:  _116.375956 43.646775   NB. Meridian
YMD=: 2023 3 27
UO=:  6                       NB. MST UTC offset

'Rs cParms'=: (YMD;UO;LB) riseset 'Algol'
'Rs cParms'=: (YMD;UO;LB) riseset 'Algol';'Rigel';'Spica'

NB. Bright Stars for 2023 3 27 Meridian
NB. https://www.almanac.com/astronomy/bright-stars/zipcode/83646/2023-03-27
Bs=: ;:'Altair Deneb Fomalhaut Algol Aldebaran Rigel Capella Bellatrix'
Bs=: Bs,;:'Betelgeuse Sirius Procyon Pollux Regulus Spica Arcturus Antares Vega'

'Rs cParms'=: (YMD;UO;LB) riseset Bs

NB. transits match fairly well rise/sets differ 5 to 10 minutes
BsTransit=: 9 18,10 8,12 25,16 35,18 2,18 41,18 43,:18 51
BsTransit=: BsTransit , 19 21,20 11,21 5,21 11,23 34,2 54,3 44,5 58,:8 4

NB. transit altitude degrees
BsAlt=: 55 88 16 87 62 38 87 52
BsAlt=: BsAlt,53 29 51 74 58 35 65 19 85

TMP=: {:"1 Rs
ALT=: ((<1;,0)&{&> TMP) ,. BsAlt
TRT=: ((<1;2 3)&{&> TMP) ,. BsTransit

NB. altitudes match to 1 degree
1 = >./ -/"1 ALT

NB. transit times match to 1 minute in worst case
1 = >./ | (60 #:^:_1 ] 0 1 {"1 TRT) - 60 #:^:_1 ] 2 3 {"1 TRT

'IAU NAV'=: loadstars 0
```

```
({."1 NAV)=: {:"1 NAV
({."1 IAU)=: {:"1 IAU
'Navrs cParms'=: (YMD;UO;LB) riseset Nav_Star_Name
'Iaurs cParms'=: (YMD;UO;LB) riseset IAU_Name

NB. default
'Meridianrs lName cParms'=: iau_today 0

NB. date of Uluru star party diner
uJD=: julfrcal uYMD=: 2022 10 19
ULURU=: 131.01941 _25.34301
uUTC=: _9.5
uLMAG=: 6.0
uLHORZ=: 5
uNAME=: 'Uluru - star party diner'
'Ulururs lName cParms'=: (uYMD;uJD;ULURU;uUTC;uLMAG;uLHORZ;uNAME) iau_today 0
'Ulururs lName cParms'=: (uYMD;uJD;ULURU;uUTC;uLMAG;uLHORZ;uNAME) nav_today 0

'Navrs lName cParms'=:(location_yellowstone~ 1933 9 25.75) iau_today 0
'Navrs lName cParms'=:(location_home~ 1956 7 18) nav_today 0
'Navrs lName cParms'=:(location_uluru~ 2043 7 2) nav_today 0

0 0$erase 'AOB Meeusmin Vrs LB YMD UO Rs Bs BsTransit BsAlt TMP ALT TRT Navrs
Iaurs cParms'
0 0$erase (;:'IAU NAV') , ({."1 NAV), {."1 IAU
0 0$erase 'uYMD uJD ULURU uUTC uLMAG uLHORZ Meridianrs Ulururs uNAME lName'

smoutput 'PASSED:: riseset_riseset_smoke'
```

[14]:
```
NB. run all the test cases in the suite
NB. suppressing all but (smoutput) output
NB. Each test will show PASSED:: if OK.
4 rtt 'riseset'
```

```
NB. (riseset) interface word(s): 20230408j134518
NB. ----------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

PASSED:: riseset_atan2_smoke
NB. (riseset) interface word(s): 20230408j134518
```

```
NB. ---------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

PASSED:: riseset_espenak_smoke
NB. (riseset) interface word(s): 20230408j134518
NB. ---------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

PASSED:: riseset_meeus_smoke
NB. (riseset) interface word(s): 20230408j134518
NB. ---------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

ECU riseset ALL/NORTH/SOUTH HrMin freq/stats ======
raw mean: _0.2796934865900383
distribution absolute minute diffs
 0  1  2  3  4 5 6 7
10 75 69 65 27 7 6 2
stats absolute minute diffs
sample size:        261
minimum:              0
maximum:              7
1st quartile:         1
2nd quartile:         2
```

```
3rd quartile:         3
first mode:           1
first antimode:       7
mean:            2.3027
std devn:        1.3489
skewness:        0.8041
kurtosis:        3.7348
PASSED:: riseset_navstars_ecu_smoke
NB. (riseset) interface word(s): 20230408j134518
NB. ----------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

SKY riseset ALL/NORTH/SOUTH HrMin freq/stats ======
raw hrmin mean: _0.02040816326530612
distribution absolute minute diffs
 0 1
48 1
stats absolute minute diffs
sample size:          49
minimum:               0
maximum:               1
1st quartile:          _
2nd quartile:          0
3rd quartile:          1
first mode:            0
first antimode:        1
mean:             0.0204
std devn:         0.1429
skewness:         6.7839
kurtosis:        47.0208
SKY riseset ALL/NORTH/SOUTH Altitude freq/stats ======
raw hrmin mean: 0.01224489795918367
distribution absolute altitude diffs
0 0.1 0.2
7  24  18
stats absolute altitude diffs
sample size:                      49
minimum:                           0
maximum:                         0.2
1st quartile:                      0
```

```
2nd quartile:                    0.1
3rd quartile:                    0.2
first mode:                      0.1
first antimode:                    0
mean:                         0.1224
std devn:        0.06850000000000001
skewness:                    _0.3095
kurtosis:                     2.1534
PASSED:: riseset_navstars_safari_smoke
NB. (riseset) interface word(s): 20230408j134518
NB. ----------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

PASSED:: riseset_riseset_smoke
NB. (riseset) interface word(s): 20230408j134518
NB. ----------------------------
NB. baby_today  NB. named Babylonian stars rising/setting today
NB. fmt_today   NB. format today verbs result
NB. iau_today   NB. named IAU stars rising/setting today
NB. loadstars   NB. loads riseset star data
NB. nav_today   NB. named navigation stars rising/setting today
NB. navdaylist  NB. sky safari 6_0 observing list of today's navigation stars
NB. riseset     NB. rise, transit, set times of stars

    fmt_today nav_today location_home 0

PASSED:: riseset_tanner_smoke
1
```

1.5 Building `riseset`

There are a number of test scripts in `futs` that build and distribute `riseset`. These scripts are tuned to my environment but they do illustrate how to *make* a distribution script.

[15]:
```
NB. show main riseset maker
portchars 0
NB. leading characters
smoutput 500 {. 1 disp 'build_riseset'
3 od ''
```

```
NB.*build_riseset t-- build (riseset) and distribute.
NB.
NB. created: 2023mar09
NB. changes: ------------------------------------------------------

coclass tmploc_AAAbuild999_=: 'AAAbuild999' [ coerase <'AAAbuild999'
coinsert 'ijod'

scrn=: 'riseset'

>0{OPENDIC=: did 0

NB. if (imex) is first dictionary on path include it
headdic=: ('imex'-:>1{OPENDIC)#'imex '

>0{od ;: headdic,'futs utils' [ 3 od ''

>0{tmploc get ;:'gettxt getmd getbyte afterlaststr read write showpass sha
+-+---------+----+-----+
|1|closed ->|futs|utils|
+-+---------+----+-----+
```

1.6 All done - thanks for playing