ORE-SWIG

Getting Started

Download and install required software. For development purposes, use GitLab repos for QuantLib and ORE.

1. Microsoft Visual Studio (including necessary program files)
2. Python (3.6 and higher)
3. Boost (preferably 1.72.0)
4. SWIG (3.0 and higher)
5. QuantLib
6. ORE

Set the following environment variables:

1. BOOST AND BOOST_LIB
2. ORE_DIR
3. SWIG_DIR and SWIG_EXECUTABLE
4. Python Scripts in PATH

To build and run ORE-SWIG, there are two methods as outlined in the README: (1) CMAKE, (2) setup.py scripts. You can build individual levels (ex. only QuantExt-SWIG) by running the following in the respective directory

```
python setup.py wrap
python setup.py build
python seutp.py test
python setup.py install
```

If using the python setup.py method, please ensure that the config files for each directory has the proper prefix path (i.e. the path to ORE on your machine).

All tests should pass.*
After proper installation, you can look through the test scripts to see the general layout, but it is as simple as using any python module. It is imperative to install so that Python recognises it and is able to use it outside of that specific environment.
**OREAnalytics on Windows runs into an error on build process.*

Troubleshooting

1. error LNK1112: Module machine type x86 conflicts with target machine type x64.
   ↳ Ensure that Python is not 3.10 (3.6 and higher)

2. error LNK2001: unresolved external symbol.
   ↳ Ensure that the ORE build has all the proper linked files in its props file.

3. error LNK1181: Input File "QuantExt-x64-mt.lib" cannot be opened.
   ↳ Ensure that ORE has been built in the correct Debug or Release version and the correct machine type (x64 vs x86).

The following fixes should come after ensuring that the classes in the interface file are up to date with the ORE classes (i.e. correct number of arguments, correct types being passed, etc.)

4. error no proxy class is created - an incomplete swigpy object of type boost::shared_ptr

   or

   if there is an error with any of the variables and after checking the type it only declares it a SwigPyObject - NOT SwigPyObject as proxy class for X

   or

   'SwigPyObject' has no attribute Y. when the attribute is actually defined in the interface.

   or

   error overloaded function, wrong type or number of arguments
   ↳ Ensure that all boost::shared_ptrs are written as ext::shared_ptr in the interface files.
   ↳ For the latter issue, you can also go into the _wrap file and print out the value of _v at the respective method's if statement to identify exactly which argument is throwing the error.

5. error: cannot find X class
   ↳ add the highlighted text to generate a text file with all the classes created during swig build.

```
os.system('swig -debug-classes -Wall -I./ -I../dependencies/
-python -py3 -c++' + '-I%s ' % swig_dir +
'-outdir QuantLib -o QuantLib/quantlib_wrap.cpp ' +
'quantlib.i > generatedClasses.txt')
```

Docker/Unix Build Errors

6. **(fixed in recent oreplus)** error cannot convert 'const boost::shared_ptr<QuantExt::YoYInflaionCapFloorEngine>' to ' const boost::shared_ptr<QuantLib::YoYInflationCapFloorEngine&> in kinterpolatedyoyoptionletvolatilitysurface.hpp.
   ↳ add QuantLib:: YoYInflationCapFloorEngine to line 58, 73, 103.

7. **(fixed in recent oreplus)** error: invalid initialization of reference of type 'const QuantExt::RandomVariable&' from expression of type '_gnu_cxx::__alloc_traits<std::allcoator<double>, double>::value_type' {aka 'double'}
   ↳ specify that the 'close_enough' function is from ql/math/conversions.hpp not qle/math/randomvariable.hpp

8. error: oreanalytics-config: not found.
   ↳ run dos2unix oreanalytics to modify newline characters so they are Unix compatible.
   In setup.py ensure that the config file is called as '. ./X-config'

9. error: cannot find qle/version.hpp
   ↳ Ensure that all libraries and directories are included during compilation.
   Located in each directory's config files for Unix through setup.py build method.

SWIG and Needed Tasks

Briefly, SWIG wraps C++ code and makes them accessible to higher level scripting languages (ex. Python). In order to do so, the general task is to write SWIG interface (.i) files that introduce the code (from .hpp file) you want to access. Be sure, when copying over to change all boost::shared_ptrs to ext::shared_ptrs.

To Do:

I. Currently, new interface files have been created but OREData and OREAnalytics require new python test scripts to confirm.

II. OREAnalytics encounters the following error when building on Windows:

```
OREData-x64-mt.lib(osutils.obj) : error LNK2001: unresolved external symbol
__imp_GetUserNameA
build\lib.win-amd64-3.6\OREAnalytics\_OREAnalytics.cp36-win_amd64.pyd:
fatal error LNK1120: 1 unresolved externals
error: command 'C:\\Program Files\\Microsoft Visual Studio\\2022\\Community\\
VC\\Tools\\MSVC\\14.32.31326\\bin\\HostX86\\x64\\link.exe'
failed with exit status 1120
```

The current hacky fix for that would be to comment out the function in OREData/utilities/osutils.* in ore. Howevwer the function is used in restore.

Classes in SWIG

QuantExt Interfaces

1. **qle_averageois.i**

   AverageOIS

   AverageONIndexedCouponPricer

2. **qle_averageoisratehelper.i**

   AverageOISRateHelper

3. **qle_cashflows.i**

   FXLinkedCashFlow

   FloatingRateFXLinkedNotionalCoupon

4. **qle_ccyswap.i**

   CrossCcySwap

   CrossCcySwapEngine

5. **qle_creditdefaultswap.i**

   QLECreditDefaultSwap

   QLEMidPointCdsEngine

   QLECdsOption

   QLEBlackCdsOptionEngine

6. **qle_crossccyfixfloatswap.i**

   CrossCcyFixFloatSwap

7. **qle_equiyforward.i**

   EquityForward

   DiscountingEquityForwardEngine

8. **qle_indexes.i**

   BEHICP

   BondIndex

   BondFuturesIndex

   ConstantMaturityBondIndex

   EquityIndex

   FXIndex

   BMAIndexWrapper

   BMAIndex

   CommodityIndex

   CommoditySpotIndex

   CommodityFuturesIndex

   qle export xibor instance

   qle export overnight instance

9. **qle_instruments.i**

   CrossCccyBasisSwap

   CrossCcyBasisSwapMtMRestSwap

   CommunityForward

   DiscountingCommodityForwardEngine

   FxForward

   DiscountingFxForward

   Payment

   PaymentDiscountingEngine

   OvernightIndexedBasisSwap

   Deposit

   DepositEngine

   DiscountingSwapEngineMultiCurve

10. **qle_ratehelpers.i**

    CrossCcyBsisSwapHelper

    CrossCcyBasisMtMResetSwapHelper

    TenorBasisSwapHelper

    SubPeriodsSwapHelper

    SubPeriodsCoupon1

    OICCBSHelper

    OIBSHelper

    BasisTwoSwapHelper

    ImmFraRateHelper

    CrossCcyFixFloatSwapHelper

11. **qle_oiccbasisswap.i**

    OvernightIndexedCrossCcyBasisSwap

    OvernightIndexedCrossCcyBasisS-
    wapEngine

12. **qle_tenorbasisswap.i**

    TenorBasisSwap

    SubPeriodsCoupon1

    SubPeriodsCouponPricer1

    SubPeriodsSwap

13. **qle_termstructures.i**
    - PriceTermStructure
    - InterpolatedPriceCurve
    - FxBlackVannaVolgaVolatilitySurface
    - BlackVarianceMoneynessSpot
    - SwaptionVolCube2
    - SwaptionVolCubeWithATM
    - SwaptionVolatilityCube
    - SwaptionVolatilityConstantSpread
    - SwapConventions
    - SwaptionVolatilityConverter
    - BlackVolatilityConverter

14. **qle_calendars.i**
    - Austria
    - Belgium
    - CME
    - Colombia
    - Cyprus
    - France
    - Greece
    - ICE
    - Ireland
    - Israel
    - IslamicWeekendsOnly
    - Luxembourg
    - Malaysia
    - Netherlands
    - Peru
    - Philippines
    - RussiaModified
    - Spain
    - Switzerland
    - Wmr
    - LargeJointCalendar

15. **qle_currencies.i**
    - TNDCurrency
    - EGPCurrency
    - NGNCurrency
    - MADCurrency
    - KZTCurrency
    - QARCurrency
    - BHDCurrency
    - OMRCurrency
    - AEDCurrency
    - PHPCurrency
    - CNHCurrency
    - MXVCurrency
    - CLFCurrency
    - XAUCurrency
    - XAGCurrency
    - XPTCurrency
    - XPDCurrency

16. **qle_coupons.i**
    - AverageONIndexedCoupon
    - CappedFlooredAverageONIndexed Coupon
    - CapFlooredAverageONIndexed CouponPricer
    - AverageONLeg

OREData Interfaces

1. **ored_conventions.i**
   - Conventions
   - ZeroRateConvention
   - DepositConvention
   - FutureConvention
   - FraConvention
   - OisConvention
   - SwapIndexConvention
   - IRSwapConvention
   - ‘AverageOisConvention
   - TenorBasisSwapConvention
   - TenorBasisTwoSwapConvention
   - BMABasisSwapConvention
   - FXConvention
   - CrossCcyBasisSwapConvention
   - CrossCcyFixFloatSwapConvention
   - CdsConvention
   - InflationSwapConvention
   - SecuritySpreadConvention
2. **ored_loader.i**
   - Loader
   - CSVLoader
   - InMemoryLoader
   - struct: Fixing
3. **ored_markets.i**
   - MarketImpl
   - YoYOptionletVolatilitySurfaceHandle
   - CPICapFloorTermPriceSurfaceHandle
   - YoYCapFloorTermPriceSurfaceHandle
   - TodaysMarket
4. **ored_markets.i**
   - MarektDatum
   - MoneyMarketQuote
   - ImmFraQuote
   - SwapQuote
   - ZeroQuote
   - DiscountQuote
   - MMFutureQuote
   - BasisSwapQuote
   - BMASwapQuote
   - CrossCcyBasisSwapQuote
   - CrossCcyFixFloatSwapQuote
   - CdsQuote
   - HazardRateQuote
   - RecoveryRateQuote
   - SwaptionQuote
   - SwaptionShiftQuote
   - CapFloorQuote
   - CapFloorShiftQuote
   - FXSpotQuote
   - FXForwardQuote
   - FXOptionQuote
   - ZcInflationFloorQuote
   - YoYInflationFloorQuote
   - YyInflationCapFloorQuote
   - SeasonalityQuote
   - EquitySpotQuote
   - EquitySpotQuote
   - EquityForwardQuote
   - EquityDividentYieldQuote
   - EquityOptionQuote
   - SecuritySpreadQuote
   - BaseCorrelationQuote
   - IndexCDSOptionQuote
   - CommoditySpotQuote
   - CommodityForwardQuote
   - CommodityOptionQuote
   - CorrelationQuote
   - CPRQuote
   - BondPriceQuote
   - BondOptionShiftQuote
   - BondOptionQuote
   - OIFUtureQuote

5. **ored_parsers.i**
   - parseIborIndex
   - parseSwapIndex
   - oarseZeroInflationIndex
   - parseFXIndex
   - parseCalendar
   - parsePeriod
   - parseBussinessDayConvention
   - parseDayCounter
   - parseCurrency
   - parseDateGenerationRule
   - parseFrequency
   - parseCompounding
   - parsePositionType
   - parseSettlementType
   - parseExerciseType
   - parseOptionType
   - parseDate
6. **ored_portfolio.i**
   - LogBuilder
   - EnginerBuilder
   - EngineFactory
   - Envelope
   - TradeFactory
   - InstrumentWrapper
   - Trade
   - Portfolio
7. **ored_curvespec.i**
   - CurveSpec
   - DefaultCurveSpec
   - CDSVolatilityCurveSpec
   - BaseCorrelationCurveSpec
   - SwaptionVolatilityCurveSpec
   - YieldVolatilityCurveSpec
   - CapFloorVolatilityCurveSpec
   - FXSpotSpec
   - FXVolatilityCurveSpec
   - InflationCurveSpec
   - InflationCapFloorVolatilityCurveSpec
   - EquityCurveSpec
   - EquityVolatilityCurveSpec
   - SecuritySpec
   - CommodityCurveSpec
   - CommodityVolatilityCurveSpec
   - CorrelationCurveSpec
8. **ored_volcurves.i**
   - GenerticYieldVolCurve
   - SwaptionVolCurve

OREAnalytics Interfaces

1. **orea_app.i**

    Paramters

    OREApp

General Warning Encountered throughout SWIG Builds

0.1 General SWIG

```
SWIG(1) : Warning 125: Use of the include path to find the input file is deprecated
and will not work with ccache. Please include the path when specifying the input file.
```

0.2 QuantLib

```
..\SWIG\exercise.i(40) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\timeseries.i(76) : Warning 321: ’open’ conflicts with a built-in name in python
..\SWIG\stochasticprocess.i(74) : Warning 321: ’apply’ conflicts with a built-in
                                               name in python
..\SWIG\swap.i(81) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\swap.i(252) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\swap.i(378) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\swap.i(549) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\inflation.i(718) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\inflation.i(1048) : Warning 321: ’slice’ conflicts with a built-in
                                         name in python
..\SWIG\bonds.i(53) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\bonds.i(445) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\capfloor.i(55) : Warning 321: ’type’ conflicts with a built-in name in python
..\SWIG\exchangerates.i(39) : Warning 321: ’type’ conflicts with a built-in
                                           name in python
..\SWIG\fdm.i(322) : Warning 321: ’apply’ conflicts with a built-in name in python
..\SWIG\fdm.i(914) : Warning 321: ’apply’ conflicts with a built-in name in python
..\SWIG\statistics.i(44) : Warning 321: ’min’ conflicts with a built-in name in python
..\SWIG\statistics.i(45) : Warning 321: ’max’ conflicts with a built-in name in python
..\SWIG\statistics.i(71) : Warning 321: ’min’ conflicts with a built-in name in python
..\SWIG\statistics.i(72) : Warning 321: ’max’ conflicts with a built-in name in python
..\SWIG\statistics.i(115) : Warning 321: ’min’ conflicts with a built-in name in python
..\SWIG\statistics.i(116) : Warning 321: ’max’ conflicts with a built-in name in python
..\SWIG\statistics.i(115) : Warning 321: ’min’ conflicts with a built-in name in python
..\SWIG\statistics.i(116) : Warning 321: ’max’ conflicts with a built-in name in python
..\SWIG\statistics.i(115) : Warning 321: ’min’ conflicts with a built-in name in python
..\SWIG\statistics.i(116) : Warning 321: ’max’ conflicts with a built-in name in python
..\SWIG\swaption.i(56) : Warning 321: ’type’ conflicts with a built-in name in python

..\SWIG\swap.i(53) : Warning 509: Overloaded method Swap::Swap(std::vector< Leg,
    std::allocator< Leg > > const &,std::vector< bool,std::allocator< bool > > const &)
    effectively ignored,
..\SWIG\swap.i(51) : Warning 509: as it is shadowed by Swap::Swap(std::vector<
    ext::shared_ptr< CashFlow >, std::allocator< ext::shared_ptr< CashFlow > > >
    const &, std::vector< ext::shared_ptr< CashFlow >, std::allocator<
    ext::shared_ptr< CashFlow > > > const &).
```

0.3 QuantExt

```
..\SWIG\qle_termstructures.i(101) : Warning 302: Identifier ’SwaptionVolatilityCube’
                                    redefined (ignored),
..\..\QuantLib-SWIG\SWIG\volatilities.i(628) : Warning 302: previous definition of
                                               ’SwaptionVolatilityCube’.
```

```
..\SWIG\qle_termstructures.i(236) : Warning 325: Nested struct not currently supported
                                    (RefData ignored)
..\SWIG\qle_averageois.i(81) : Warning 314: 'None' is a python keyword, renaming to '_None'
..\SWIG\qle_termstructures.i(219) : Warning 401: Nothing known about base class 'Observer'.
                                    Ignored.
..\SWIG\qle_termstructures.i(251) : Warning 401: Nothing known about base class
                                    'QuantLib::VolatilityTermStructure'. Ignored.
```

0.4 OREData

```
..\SWIG\ored_market.i(178) : Warning 302: Identifier 'YoYOptionletVolatilitySurfaceHandle'
                             redefined (ignored) (Renamed from
                             'Handle< QuantExt::YoYOptionletVolatilitySurface >'),
..\..\QuantLib-SWIG\SWIG\volatilities.i(176) : Warning 302: previous definition of
                                               'YoYOptionletVolatilitySurfaceHandle'
                                               (Renamed from
                                               'Handle< YoYOptionletVolatilitySurface >').
```