In [1]:

```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# Comment this if the data visualisations doesn't work on your side
%matplotlib inline

plt.style.use('bmh')
```

In [2]:

```
df = pd.read_csv("train.csv")
df.head()
```

Out[2]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Ut
0	1	60	RL	65.0	8450	Pave	NaN	Reg	Lvl	A
1	2	20	RL	80.0	9600	Pave	NaN	Reg	Lvl	A
2	3	60	RL	68.0	11250	Pave	NaN	IR1	Lvl	A
3	4	70	RL	60.0	9550	Pave	NaN	IR1	Lvl	A
4	5	60	RL	84.0	14260	Pave	NaN	IR1	Lvl	A

5 rows × 81 columns

In [3]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1460 entries, 0 to 1459
Data columns (total 81 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             1460 non-null   int64
 1   MSSubClass     1460 non-null   int64
 2   MSZoning       1460 non-null   object
 3   LotFrontage    1201 non-null   float64
 4   LotArea        1460 non-null   int64
 5   Street         1460 non-null   object
 6   Alley          91 non-null     object
 7   LotShape       1460 non-null   object
 8   LandContour    1460 non-null   object
 9   Utilities      1460 non-null   object
 10  LotConfig      1460 non-null   object
 11  LandSlope      1460 non-null   object
 12  Neighborhood   1460 non-null   object
 13  Condition1     1460 non-null   object
 14  Condition2     1460 non-null   object
 15  BldgType       1460 non-null   object
 16  HouseStyle     1460 non-null   object
 17  OverallQual    1460 non-null   int64
 18  OverallCond    1460 non-null   int64
 19  YearBuilt      1460 non-null   int64
 20  YearRemodAdd   1460 non-null   int64
 21  RoofStyle      1460 non-null   object
 22  RoofMatl       1460 non-null   object
 23  Exterior1st    1460 non-null   object
 24  Exterior2nd    1460 non-null   object
 25  MasVnrType     1452 non-null   object
 26  MasVnrArea     1452 non-null   float64
 27  ExterQual      1460 non-null   object
 28  ExterCond      1460 non-null   object
 29  Foundation     1460 non-null   object
 30  BsmtQual       1423 non-null   object
 31  BsmtCond       1423 non-null   object
 32  BsmtExposure   1422 non-null   object
 33  BsmtFinType1   1423 non-null   object
 34  BsmtFinSF1     1460 non-null   int64
 35  BsmtFinType2   1422 non-null   object
 36  BsmtFinSF2     1460 non-null   int64
 37  BsmtUnfSF      1460 non-null   int64
 38  TotalBsmtSF    1460 non-null   int64
 39  Heating        1460 non-null   object
 40  HeatingQC      1460 non-null   object
 41  CentralAir     1460 non-null   object
 42  Electrical     1459 non-null   object
 43  1stFlrSF       1460 non-null   int64
 44  2ndFlrSF       1460 non-null   int64
 45  LowQualFinSF   1460 non-null   int64
 46  GrLivArea      1460 non-null   int64
 47  BsmtFullBath   1460 non-null   int64
 48  BsmtHalfBath   1460 non-null   int64
 49  FullBath       1460 non-null   int64
 50  HalfBath       1460 non-null   int64
```

```
 51  BedroomAbvGr   1460 non-null   int64
 52  KitchenAbvGr   1460 non-null   int64
 53  KitchenQual    1460 non-null   object
 54  TotRmsAbvGrd   1460 non-null   int64
 55  Functional     1460 non-null   object
 56  Fireplaces     1460 non-null   int64
 57  FireplaceQu    770 non-null    object
 58  GarageType     1379 non-null   object
 59  GarageYrBlt    1379 non-null   float64
 60  GarageFinish   1379 non-null   object
 61  GarageCars     1460 non-null   int64
 62  GarageArea     1460 non-null   int64
 63  GarageQual     1379 non-null   object
 64  GarageCond     1379 non-null   object
 65  PavedDrive     1460 non-null   object
 66  WoodDeckSF     1460 non-null   int64
 67  OpenPorchSF    1460 non-null   int64
 68  EnclosedPorch  1460 non-null   int64
 69  3SsnPorch      1460 non-null   int64
 70  ScreenPorch    1460 non-null   int64
 71  PoolArea       1460 non-null   int64
 72  PoolQC         7 non-null      object
 73  Fence          281 non-null    object
 74  MiscFeature    54 non-null     object
 75  MiscVal        1460 non-null   int64
 76  MoSold         1460 non-null   int64
 77  YrSold         1460 non-null   int64
 78  SaleType       1460 non-null   object
 79  SaleCondition  1460 non-null   object
 80  SalePrice      1460 non-null   int64
dtypes: float64(3), int64(35), object(43)
memory usage: 924.0+ KB
```

In [4]:

```
# df.count() does not include NaN values
df2 = df[[column for column in df if df[column].count() / len(df) >= 0.3]]
del df2['Id']
print("List of dropped columns:", end=" ")
for c in df.columns:
    if c not in df2.columns:
        print(c, end=", ")
print('\n')
df = df2
```

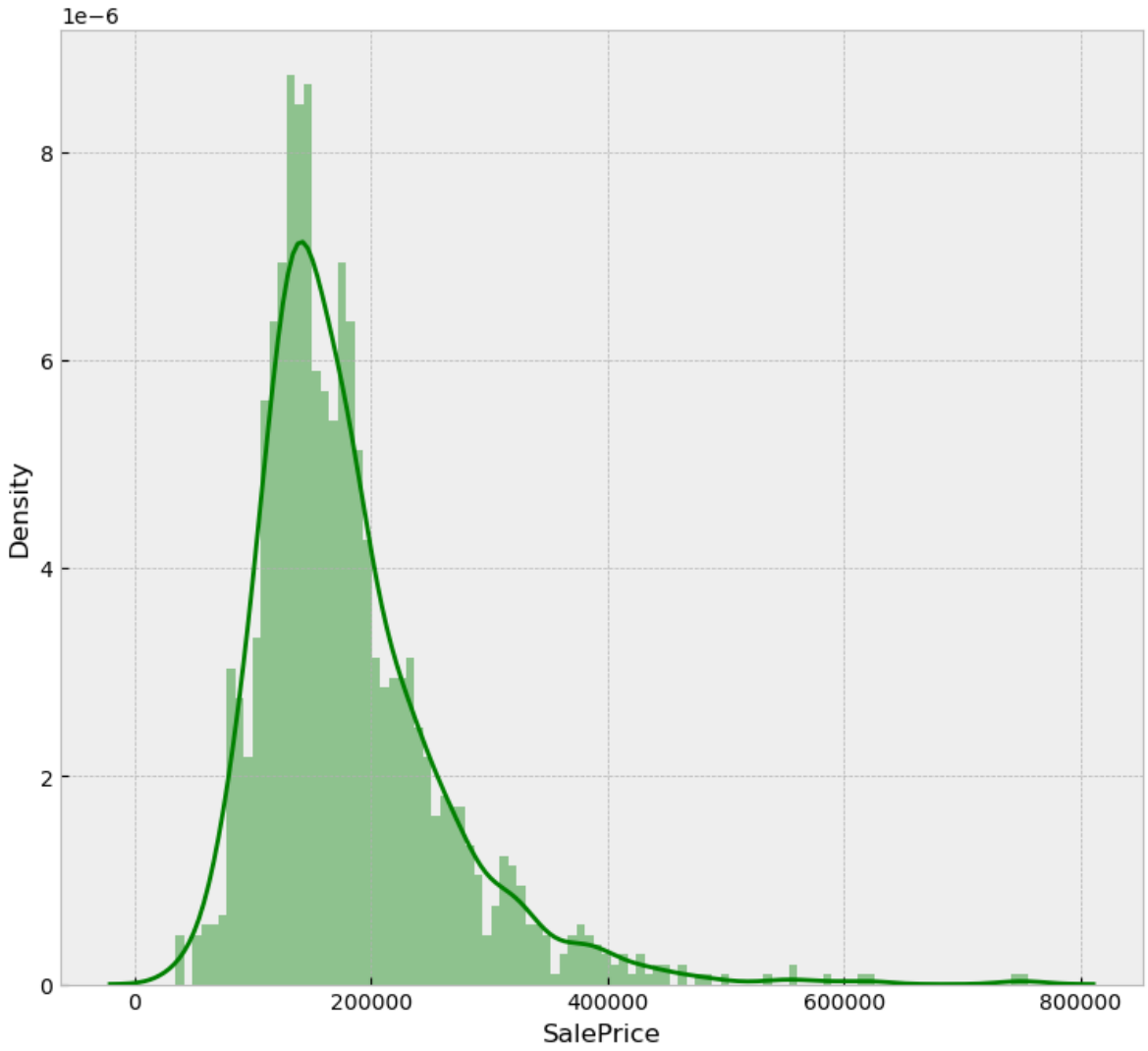
```
List of dropped columns: Id, Alley, PoolQC, Fence, MiscFeature,
```

In [5]:

```
print(df['SalePrice'].describe())
plt.figure(figsize=(9, 8))
sns.distplot(df['SalePrice'], color='g', bins=100, hist_kws={'alpha': 0.4});
```

```
count      1460.000000
mean     180921.195890
std       79442.502883
min       34900.000000
25%      129975.000000
50%      163000.000000
75%      214000.000000
max      755000.000000
Name: SalePrice, dtype: float64

C:\Users\hp\anaconda3\lib\site-packages\seaborn\distributions.py:2619: Futur
eWarning: `distplot` is a deprecated function and will be removed in a futur
e version. Please adapt your code to use either `displot` (a figure-level fu
nction with similar flexibility) or `histplot` (an axes-level function for h
istograms).
  warnings.warn(msg, FutureWarning)
```



In [8]:

```
list(set(df.dtypes.tolist()))
```

Out[8]:

```
[dtype('O'), dtype('float64'), dtype('int64')]
```

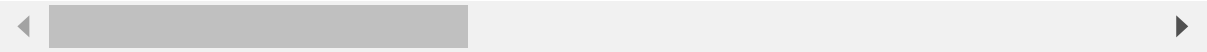
In [9]:

```
df_num = df.select_dtypes(include = ['float64', 'int64'])
df_num.head()
```

Out[9]:

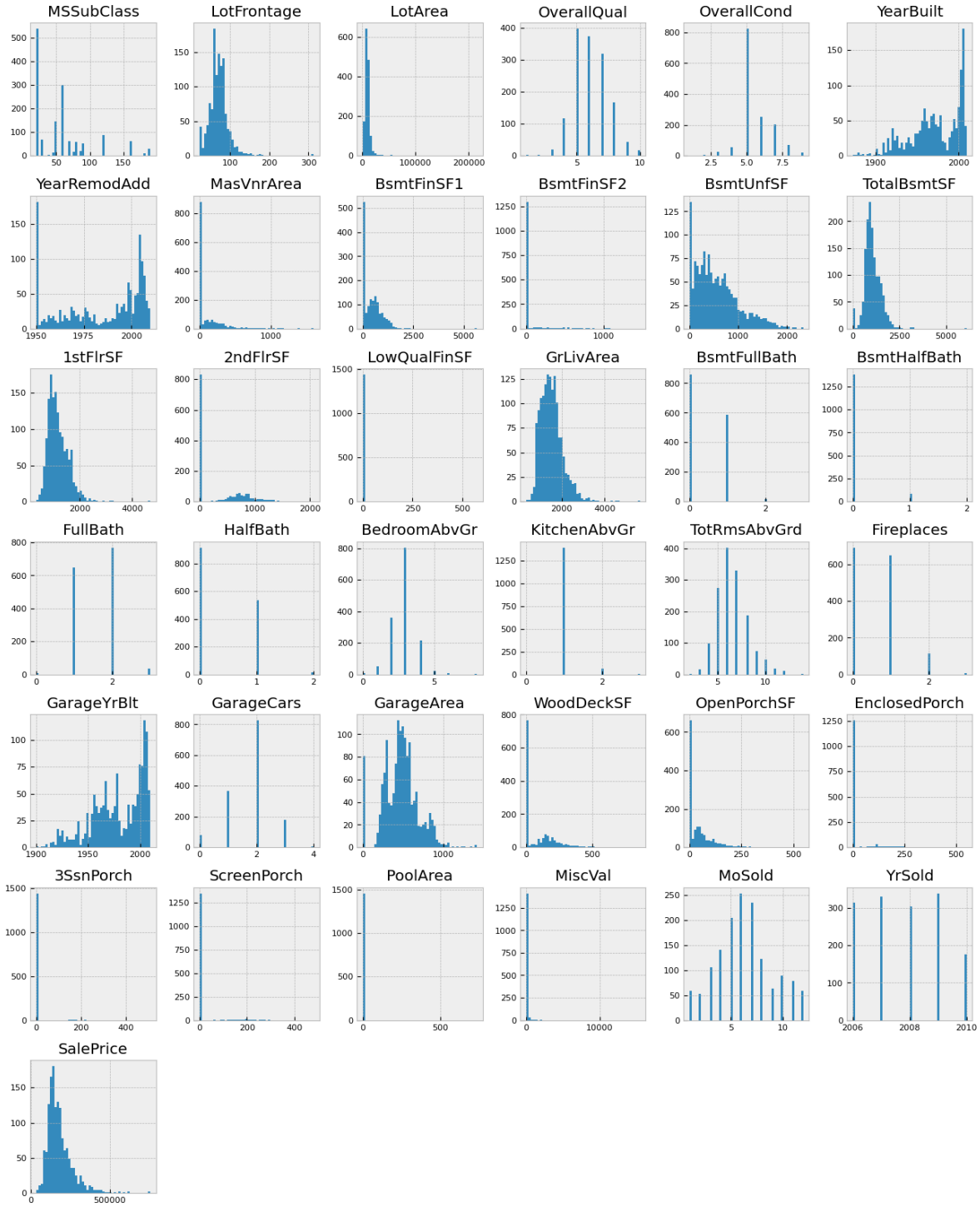
	MSSubClass	LotFrontage	LotArea	OverallQual	OverallCond	YearBuilt	YearRemodAdd	Ma
0	60	65.0	8450	7	5	2003	2003	
1	20	80.0	9600	6	8	1976	1976	
2	60	68.0	11250	7	5	2001	2002	
3	70	60.0	9550	7	5	1915	1970	
4	60	84.0	14260	8	5	2000	2000	

5 rows × 37 columns



In [10]:

```
df_num.hist(figsize=(16, 20), bins=50, xlabelsize=8, ylabelsize=8);
```



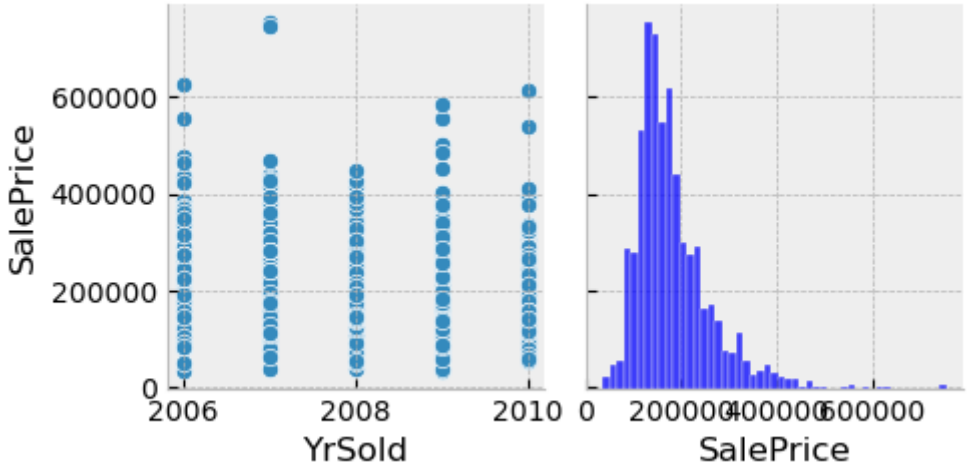
In [11]:

```
df_num_corr = df_num.corr()['SalePrice'][:-1] # -1 because the latest row is SalePrice
golden_features_list = df_num_corr[abs(df_num_corr) > 0.5].sort_values(ascending=False)
print("There is {} strongly correlated values with SalePrice:\n{}".format(len(golden_featur
```

```
There is 10 strongly correlated values with SalePrice:
OverallQual     0.790982
GrLivArea       0.708624
GarageCars      0.640409
GarageArea      0.623431
TotalBsmtSF     0.613581
1stFlrSF        0.605852
FullBath        0.560664
TotRmsAbvGrd    0.533723
YearBuilt       0.522897
YearRemodAdd    0.507101
Name: SalePrice, dtype: float64
```

In [12]:

```
for i in range(0, len(df_num.columns), 5):
    sns.pairplot(data=df_num,
                 x_vars=df_num.columns[i:i+5],
                 y_vars=['SalePrice'])
```


SalePrice
600000
400000
200000
0
2006
2008
2010
YrSold
0
200000
400000
600000
SalePrice

In [13]:

```
import operator

individual_features_df = []
for i in range(0, len(df_num.columns) - 1): # -1 because the last column is SalePrice
    tmpDf = df_num[[df_num.columns[i], 'SalePrice']]
    tmpDf = tmpDf[tmpDf[df_num.columns[i]] != 0]
    individual_features_df.append(tmpDf)

all_correlations = {feature.columns[0]: feature.corr()['SalePrice'][0] for feature in indiv
all_correlations = sorted(all_correlations.items(), key=operator.itemgetter(1))
for (key, value) in all_correlations:
    print("{:>15}: {:>15}".format(key, value))
```

```
   KitchenAbvGr: -0.1392006921778576
       HalfBath: -0.08439171127179902
    MSSubClass: -0.08428413512659509
    OverallCond: -0.07785589404867797
         YrSold: -0.028922585168736813
   BsmtHalfBath: -0.02883456718548182
       PoolArea: -0.014091521506356765
   BsmtFullBath: 0.011439163340408606
         MoSold: 0.046432245223819446
      3SsnPorch: 0.06393243256889088
    OpenPorchSF: 0.08645298857147718
        MiscVal: 0.08896338917298921
     Fireplaces: 0.12166058421363891
      BsmtUnfSF: 0.16926100049514173
   BedroomAbvGr: 0.18093669310848806
     WoodDeckSF: 0.1937060123752066
     BsmtFinSF2: 0.19895609430836594
  EnclosedPorch: 0.24127883630117497
    ScreenPorch: 0.2554300795487841
        LotArea: 0.2638433538714051
   LowQualFinSF: 0.30007501655501323
    LotFrontage: 0.35179909657067737
     MasVnrArea: 0.43409021975689227
     BsmtFinSF1: 0.47169042652357296
    GarageYrBlt: 0.4863616774878596
   YearRemodAdd: 0.5071009671113866
      YearBuilt: 0.5228973328794967
   TotRmsAbvGrd: 0.5337231555820284
       FullBath: 0.5745626737760822
       1stFlrSF: 0.6058521846919153
     GarageArea: 0.6084052829168346
    TotalBsmtSF: 0.6096808188074374
     GarageCars: 0.6370954062078923
       2ndFlrSF: 0.6733048324568376
      GrLivArea: 0.7086244776126515
    OverallQual: 0.7909816005838053
```

In [14]:

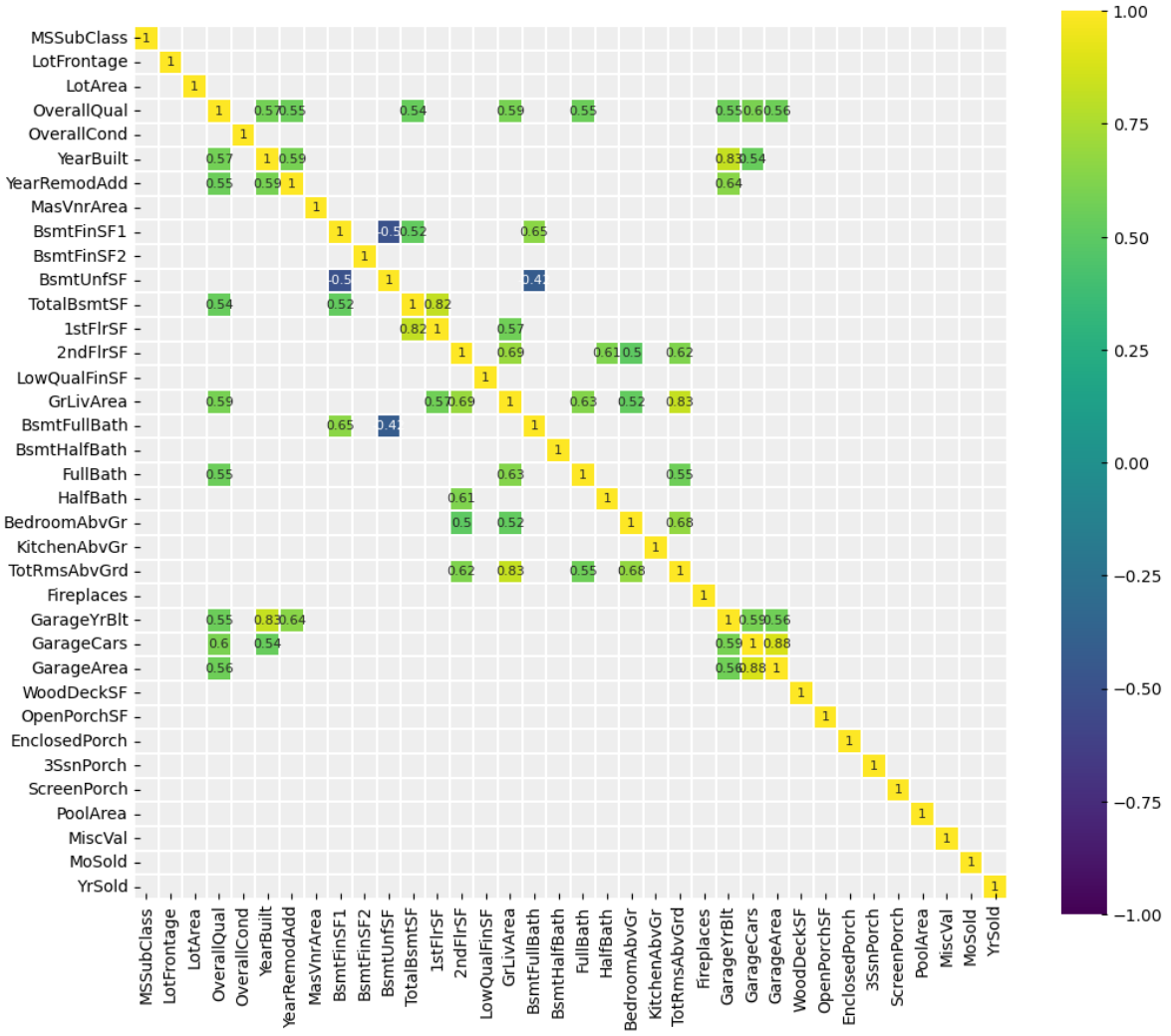
```
golden_features_list = [key for key, value in all_correlations if abs(value) >= 0.5]
print("There is {} strongly correlated values with SalePrice:\n{}".format(len(golden_featur
```

```
There is 11 strongly correlated values with SalePrice:
['YearRemodAdd', 'YearBuilt', 'TotRmsAbvGrd', 'FullBath', '1stFlrSF', 'Garag
eArea', 'TotalBsmtSF', 'GarageCars', '2ndFlrSF', 'GrLivArea', 'OverallQual']
```

In [15]:

```
corr = df_num.drop('SalePrice', axis=1).corr() # We already examined SalePrice correlations
plt.figure(figsize=(12, 10))

sns.heatmap(corr[(corr >= 0.5) | (corr <= -0.4)],
            cmap='viridis', vmax=1.0, vmin=-1.0, linewidths=0.1,
            annot=True, annot_kws={"size": 8}, square=True);
```



In [16]:

```
quantitative_features_list = ['LotFrontage', 'LotArea', 'MasVnrArea', 'BsmtFinSF1', 'BsmtFi
    '2ndFlrSF', 'LowQualFinSF', 'GrLivArea', 'BsmtFullBath', 'BsmtHalfBath', 'FullBath', 'H
    'BedroomAbvGr', 'KitchenAbvGr', 'TotRmsAbvGrd', 'Fireplaces', 'GarageCars', 'GarageArea
    'EnclosedPorch', '3SsnPorch', 'ScreenPorch', 'PoolArea', 'MiscVal', 'SalePrice']
df_quantitative_values = df[quantitative_features_list]
df_quantitative_values.head()
```

Out[16]:

	LotFrontage	LotArea	MasVnrArea	BsmtFinSF1	BsmtFinSF2	TotalBsmtSF	1stFlrSF	2ndFlr
0	65.0	8450	196.0	706	0	856	856	8
1	80.0	9600	0.0	978	0	1262	1262	
2	68.0	11250	162.0	486	0	920	920	8
3	60.0	9550	0.0	216	0	756	961	7
4	84.0	14260	350.0	655	0	1145	1145	1(

5 rows × 28 columns

In [17]:

```
features_to_analyse = [x for x in quantitative_features_list if x in golden_features_list]
features_to_analyse.append('SalePrice')
features_to_analyse
```

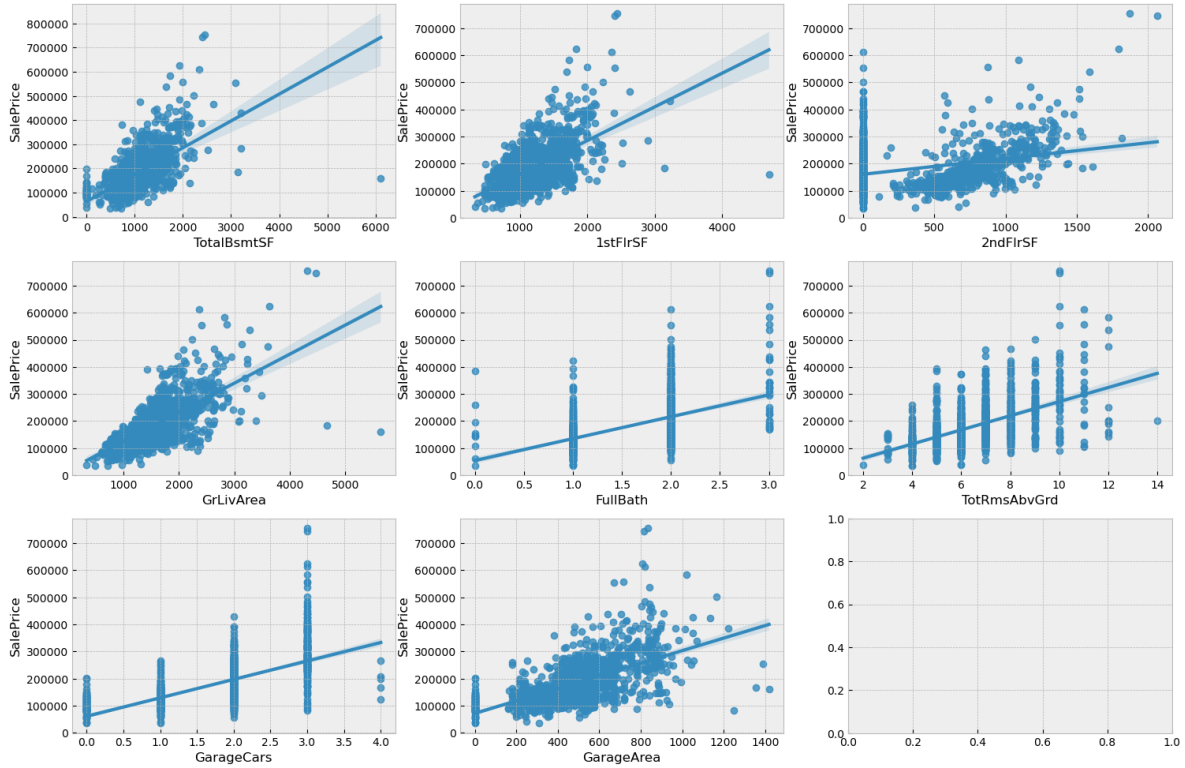
Out[17]:

```
['TotalBsmtSF',
 '1stFlrSF',
 '2ndFlrSF',
 'GrLivArea',
 'FullBath',
 'TotRmsAbvGrd',
 'GarageCars',
 'GarageArea',
 'SalePrice']
```

In [18]:

```
fig, ax = plt.subplots(round(len(features_to_analyse) / 3), 3, figsize = (18, 12))

for i, ax in enumerate(fig.axes):
    if i < len(features_to_analyse) - 1:
        sns.regplot(x=features_to_analyse[i],y='SalePrice', data=df[features_to_analyse], a
```



In [19]:

```
# quantitative_features_list[:-1] as the last column is SalePrice and we want to keep it
categorical_features = [a for a in quantitative_features_list[:-1] + df.columns.tolist() if
df_categ = df[categorical_features]
df_categ.head()
```

Out[19]:

	MSSubClass	MSZoning	Street	LotShape	LandContour	Utilities	LotConfig	LandSlope	Nei
0	60	RL	Pave	Reg	Lvl	AllPub	Inside	Gtl	
1	20	RL	Pave	Reg	Lvl	AllPub	FR2	Gtl	
2	60	RL	Pave	IR1	Lvl	AllPub	Inside	Gtl	
3	70	RL	Pave	IR1	Lvl	AllPub	Corner	Gtl	
4	60	RL	Pave	IR1	Lvl	AllPub	FR2	Gtl	

5 rows × 49 columns

In [20]:

```
df_not_num = df_categ.select_dtypes(include = ['O'])
print('There is {} non numerical features including:\n{}'.format(len(df_not_num.columns), d
```

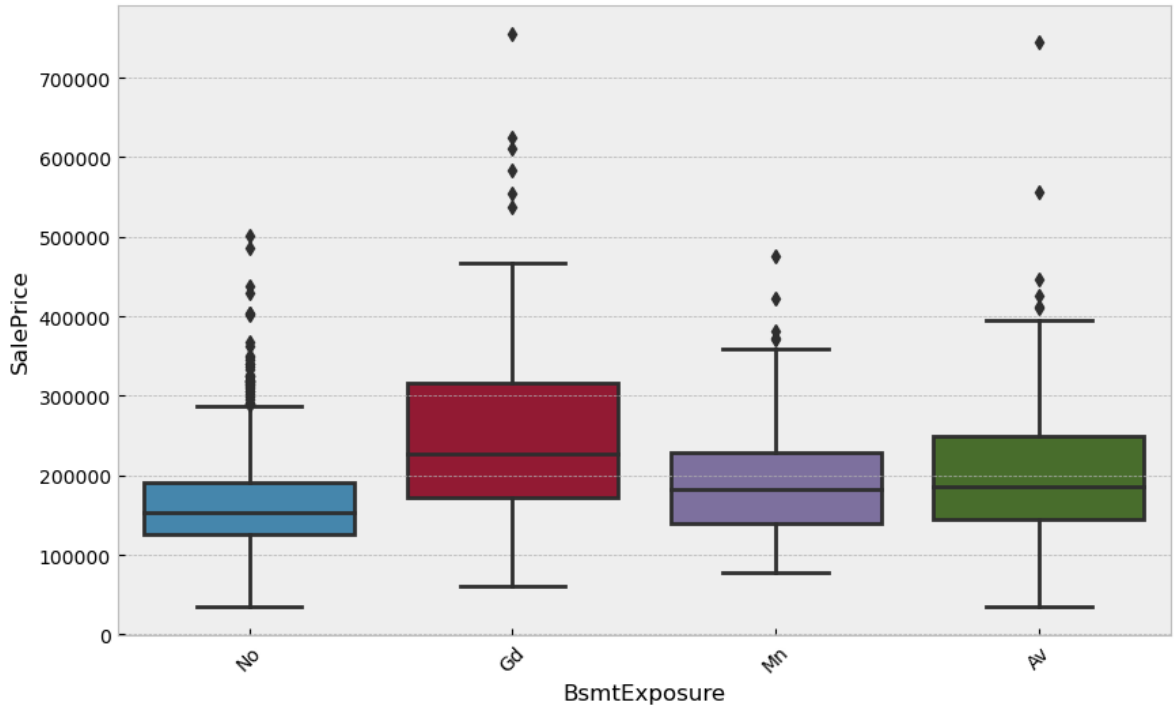
```
There is 39 non numerical features including:
['MSZoning', 'Street', 'LotShape', 'LandContour', 'Utilities', 'LotConfig',
'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType', 'HouseS
tyle', 'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType',
'ExterQual', 'ExterCond', 'Foundation', 'BsmtQual', 'BsmtCond', 'BsmtExposur
e', 'BsmtFinType1', 'BsmtFinType2', 'Heating', 'HeatingQC', 'CentralAir', 'E
lectrical', 'KitchenQual', 'Functional', 'FireplaceQu', 'GarageType', 'Garag
eFinish', 'GarageQual', 'GarageCond', 'PavedDrive', 'SaleType', 'SaleConditi
on']
```

In [21]:

```
plt.figure(figsize = (10, 6))
ax = sns.boxplot(x='BsmtExposure', y='SalePrice', data=df_categ)
plt.setp(ax.artists, alpha=.5, linewidth=2, edgecolor="k")
plt.xticks(rotation=45)
```

Out[21]:

```
(array([0, 1, 2, 3]),
 [Text(0, 0, 'No'), Text(1, 0, 'Gd'), Text(2, 0, 'Mn'), Text(3, 0, 'Av')])
```

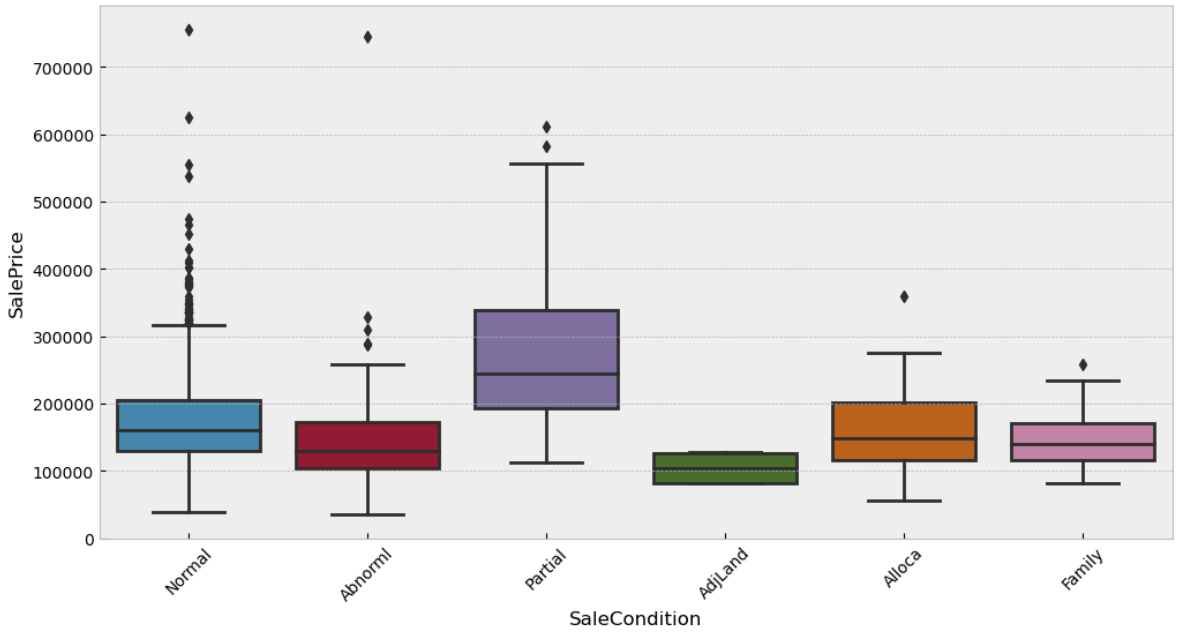


In [22]:

```
plt.figure(figsize = (12, 6))
ax = sns.boxplot(x='SaleCondition', y='SalePrice', data=df_categ)
plt.setp(ax.artists, alpha=.5, linewidth=2, edgecolor="k")
plt.xticks(rotation=45)
```

Out[22]:

```
(array([0, 1, 2, 3, 4, 5]),
 [Text(0, 0, 'Normal'),
  Text(1, 0, 'Abnorml'),
  Text(2, 0, 'Partial'),
  Text(3, 0, 'AdjLand'),
  Text(4, 0, 'Alloca'),
  Text(5, 0, 'Family')])
```

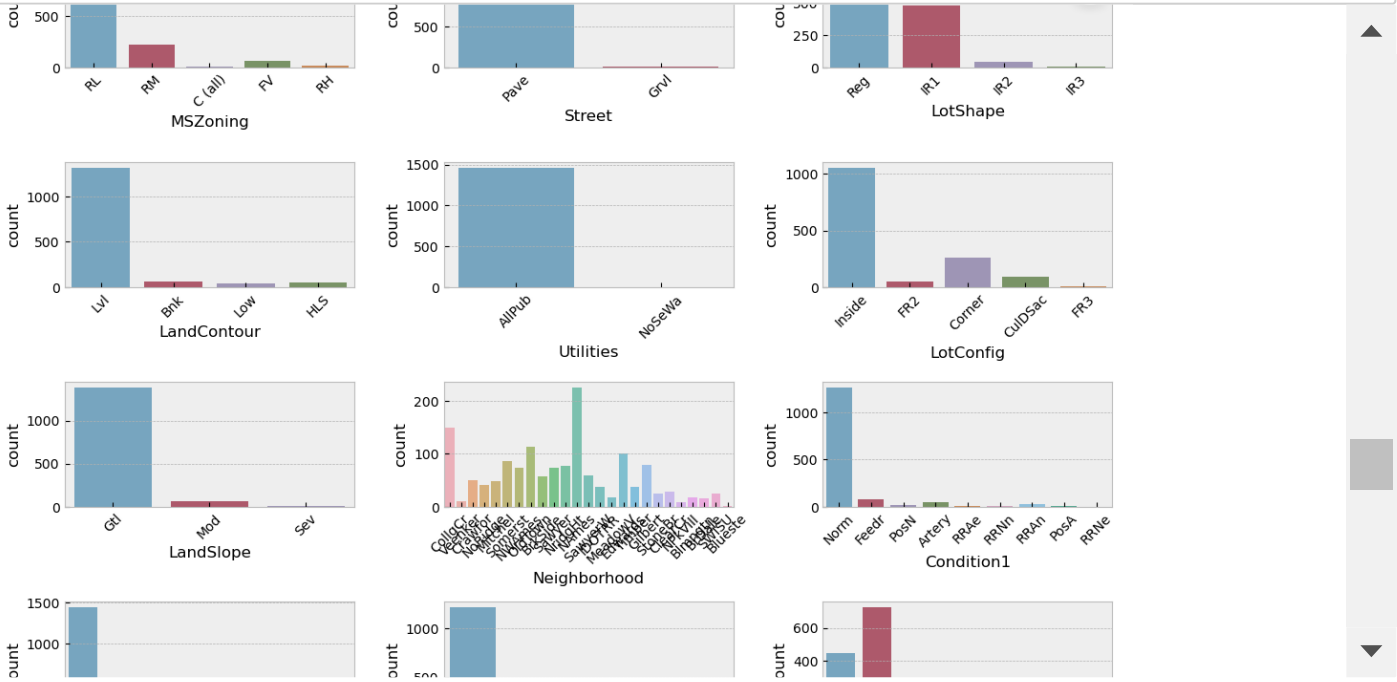


In [23]:

```
fig, axes = plt.subplots(round(len(df_not_num.columns) / 3), 3, figsize=(12, 30))

for i, ax in enumerate(fig.axes):
    if i < len(df_not_num.columns):
        ax.set_xticklabels(ax.xaxis.get_majorticklabels(), rotation=45)
        sns.countplot(x=df_not_num.columns[i], alpha=0.7, data=df_not_num, ax=ax)

fig.tight_layout()
```



In [ ]: