Importing the packages

In [5]:

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

```

Objectve: To perform an Exploratory analysis on Haberman Dataset, Studying the features and represent the findings

Reading the data

In [6]:

```
haberman_data=pd.read_csv(r"C:\Users\Ankesh\Kaggle Dataset\haberman.csv")
haberman_data.head(4)
#objective is to find out if we have the age and the lymph nodes,
# what is the possibilty of the patient to have to status of 1 or 2
```

Out[6]:

	age	year	nodes	status
0	30	64	1	1
1	30	62	3	1
2	30	65	0	1
3	31	59	2	1

Task: Describe the correlation of features age,year and affected lymph nodes deiciding the status of patient survival

In [41]:

```
haberman_data.columns
```

Out[41]:

```
Index(['age', 'year', 'nodes', 'status'], dtype='object')
```

Features given:

Age: Age of the patient during operation

Year: Year of the operation

Nodes: Number of affected lymph nodes when patient got admission

Survival Status: It represents whether patient survive more than 5 years or less after surgery.

Here if patients survived 5 years or more is represented as 1 patients who survived less than 5 years is represented as 2.

Shape of Data

In [42]:

```
1 haberman_data.shape
```

Out[42]:

```
(306, 4)
```

Describing the whole dataset and observing the min, max, avg of all the feature

In [44]:

```
1 haberman_data.describe(include='all')
```

Out[44]:

	age	year	nodes	status
count	306.000000	306.000000	306.000000	306.000000
mean	52.457516	62.852941	4.026144	1.264706
std	10.803452	3.249405	7.189654	0.441899
min	30.000000	58.000000	0.000000	1.000000
25%	44.000000	60.000000	0.000000	1.000000
50%	52.000000	63.000000	1.000000	1.000000
75%	60.750000	65.750000	4.000000	2.000000
max	83.000000	69.000000	52.000000	2.000000

Checking for columns with null values

In [47]:

```
1 haberman_data.isnull().sum()
```

Out[47]:

```
age       0
year      0
nodes     0
status    0
dtype: int64
```

Start and End date of the surgery and its count:

1958 was the year in which we had most no of surgeries/patient encountered, 1969 was the year in which we had least no of surgeries/patient encountered

In [11]:

```
haberman_data.year.min()
#year in which survey started
```

Out[11]:

```
58
```

In [12]:

```
haberman_data.year.max()
#year in which survey ended
```

Out[12]:

```
69
```

In [18]:

```
haberman_data.year.value_counts()
```

Out[18]:

```
58    36
64    31
63    30
66    28
65    28
60    28
59    27
61    26
67    25
62    23
68    13
69    11
Name: year, dtype: int64
```

Understanding Lymph Nodes:

The lymph nodes try to catch and trap cancer cells before they reach other parts of the body. A lymph node in the area of the armpit (axilla) to which cancer has spread. This spread is determined by surgically removing some of the lymph nodes and examining them under a microscope to see whether cancer cells are present

In [48]:

```
print ("lymph node minimum: {}".format(haberman_data.nodes.min()))
print ("lymph node maximum: {}".format(haberman_data.nodes.max()))

```

```
lymph node minimum: 0
lymph node maximum: 52
```

Survival Status of Patients:

out of 306 patients, 225 patients survived for more than 5 years out of 306 patients, 81 patients survided for less than 5 years

In [49]:

```
haberman_data['status'].value_counts()

```

Out[49]:

```
1    225
2     81
Name: status, dtype: int64
```

Visualization of data

"""1D scatter plot"""

In [50]:

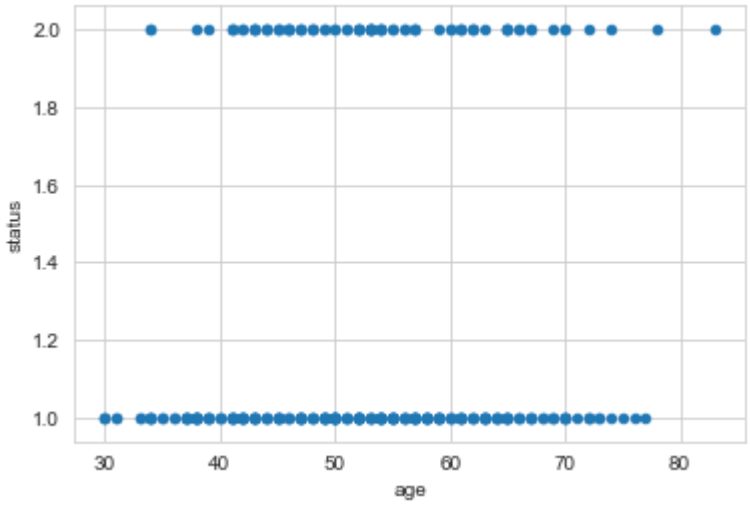
```


haberman_data.plot(x='age',y='status',kind='scatter')

```

Out[50]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2088ae34cf8>
```



My analysis:

Patient of age group (30-40) and (72-77) have survived has status as 1: meaning they have survived for more than 5 years

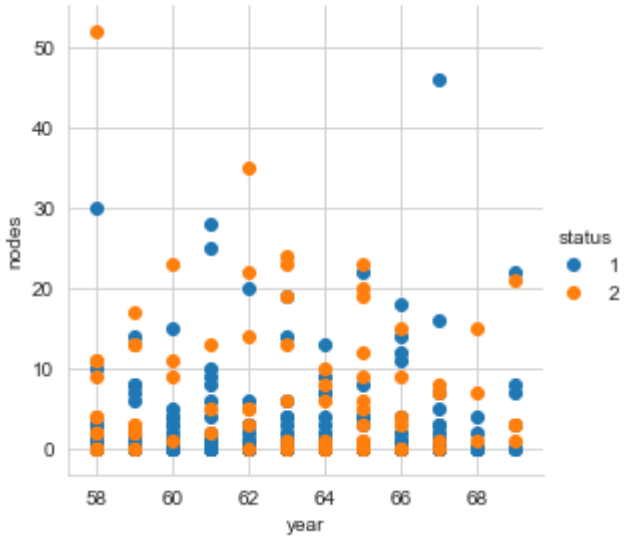
Plotting Faceplot

In [52]:

```
sns.FacetGrid(data=haberman_data,hue='status',height=4).map(plt.scatter,'year','nodes'
```

Out[52]:

```
<seaborn.axisgrid.FacetGrid at 0x2088ae8b7b8>
```



My Analysis:

lymph nodes detected for most of the patients applicable to all age group were less than 20 during surgery.

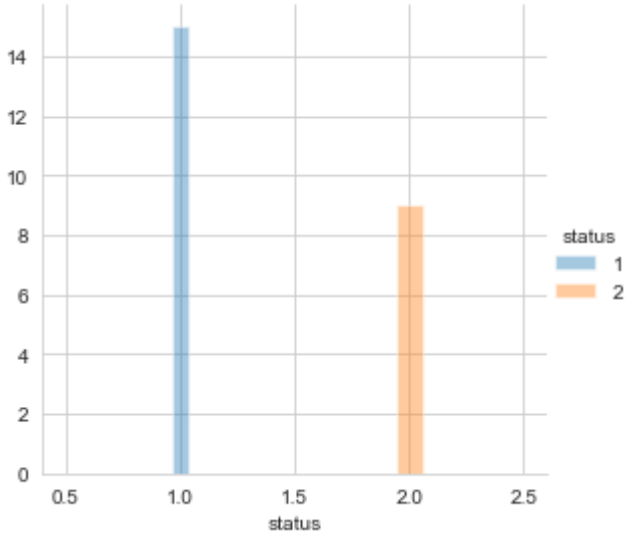
Plotting to check desnity between patient with status 1 over 2

In [57]:

```
sns.FacetGrid(data=haberman_data,hue='status',height=4).map(sns.distplot,'status').add
```

Out[57]:

```
<seaborn.axisgrid.FacetGrid at 0x2088af30ac8>
```



My Analysis:

In the survey,more patients have survived for more than 5 years, Surgery has been efficiecnt here

PLotting the pair plot for more clear visualisation across multiple features

In [60]:

```
sns.pairplot(data=haberman_data,hue='status', vars=['year','age','nodes'],height=3)
sns.set_style('whitegrid')
```

Insights from pair plot:

Patient having status 2 (survied less than 5 years) were older than patient with status 1

Diving data Status wise

In [22]:

```
haberman_data_longsurvive=haberman_data.loc[haberman_data['status']==1]
haberman_data_shortsurvive=haberman_data.loc[haberman_data['status']==2]
```

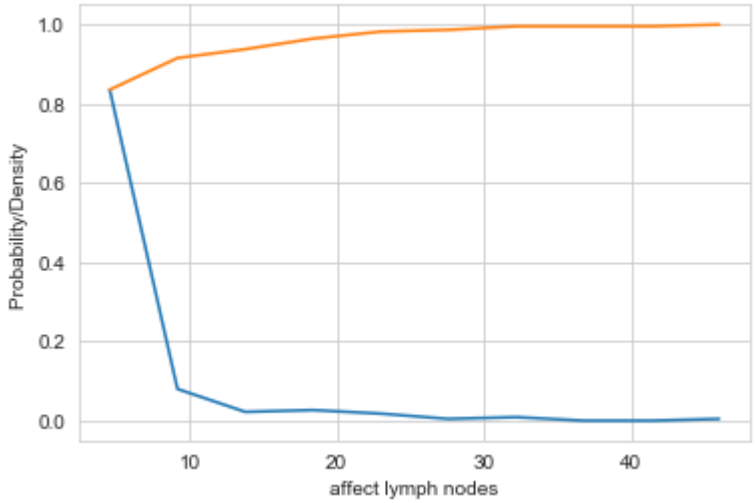
"""PDF and CDF of nodes as per patient status 1"""

In [63]:

```

counts,edges=np.histogram(haberman_data_longsurvive['nodes'],bins=10,density=True)
pdf=counts/sum(counts)
cdf=np.cumsum(pdf)
plt.xlabel('affect lymph nodes')
plt.ylabel('Probability/Density ')
plt.plot(edges[1:],pdf)
plt.plot(edges[1:],cdf)
plt.show()

```



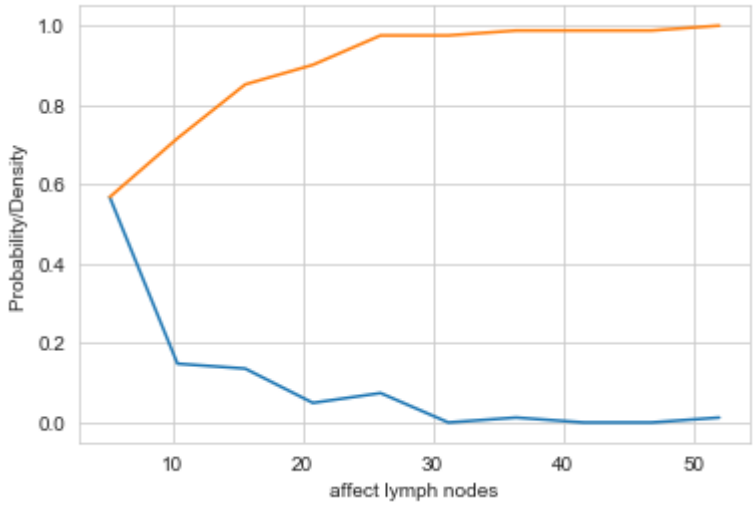
"""PDF and CDF of nodes as per patient status 2 """

In [64]:

```
counts,edges=np.histogram(haberman_data_shortsurvive['nodes'],bins=10,density=True)
pdf=counts/sum(counts)
cdf=np.cumsum(pdf)
plt.xlabel('affect lymph nodes')
plt.ylabel('Probability/Density ')
plt.plot(edges[1:],pdf)
plt.plot(edges[1:],cdf)
```

Out[64]:

```
[<matplotlib.lines.Line2D at 0x2088c6d9f28>]
```



"""Analysis with the PDF and CDF based on affected lymph nodes

Status 1 if the affected lymph nodes is less than 10, probability is 80% patient will be status 1 if the affected lymph nodes more than 35, probability is 95% patient will be stage 1

Status 2 if the affected lymph nodes is less than 10, probability is 65% patient will be status 2 if the affected lymph nodes is more than 35 probability is 95% patient will be status 2

"""

PDF and CDF of age with respect to patient's survival status

"""PDF and CDF with age for status 1 patient"""

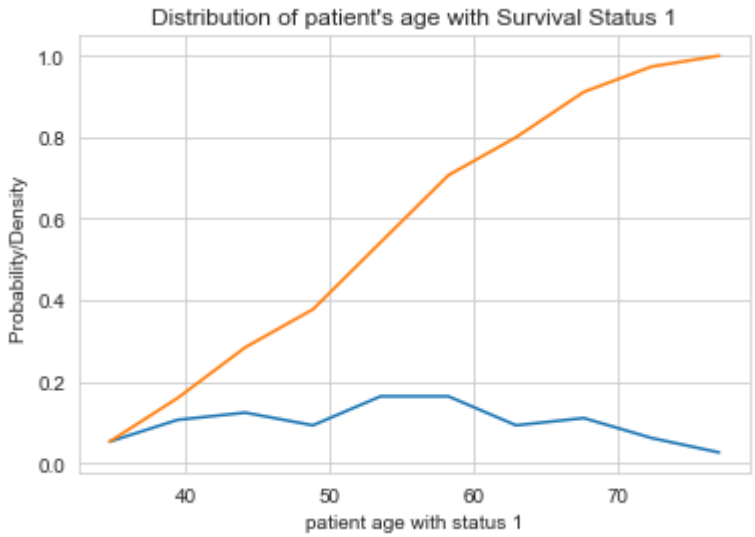
In [71]:

```
counts,edges=np.histogram(haberman_data_longsurvive['age'],bins=10,density=True)
pdf=counts/sum(counts)
cdf=np.cumsum(pdf)
plt.xlabel('patient age with status 1')
plt.ylabel('Probability/Density ')
plt.title("Distribution of patient's age with Survival Status 1")

plt.plot(edges[1:],pdf)
plt.plot(edges[1:],cdf)
```

Out[71]:

```
[<matplotlib.lines.Line2D at 0x2088c679588>]
```



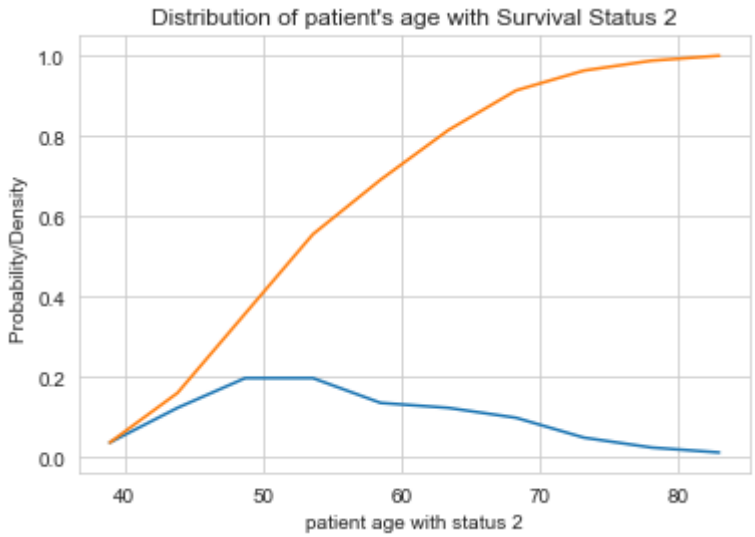
"""PDF and CDF of age as per patient status 2"""

In [70]:

```
counts,edges=np.histogram(haberman_data_shortsurvive['age'],bins=10,density=True)
pdf=counts/sum(counts)
cdf=np.cumsum(pdf)
plt.xlabel('patient age with status 2')
plt.ylabel('Probability/Density ')
plt.title("Distribution of patient's age with Survival Status 2")
plt.plot(edges[1:],pdf)
plt.plot(edges[1:],cdf)
```

Out[70]:

```
[<matplotlib.lines.Line2D at 0x2088c695e10>]
```



Analysis based on PDF, CDF of age

Most number of patients with staus 1 are from age 55-60 with survival rate of 44% Least number of patients with status 1 are from age group 75-80 with survival rate of 100%

Success rate of surgery of 100% has been observed as patient with age > 70 years

Success rate of surgery of 7.5% has been observed as patient with age <45 years

Most number of patients with status 2 are from age 48-55 with survival rate of 40% Least number of patients with status 2 are from age 75-85 with survival rate of 100%

Success rate of surgery with 100% has been observed as pateint with age > 75 years Success rate of surgery of with 7.5% has been observed for patient with age <45 years

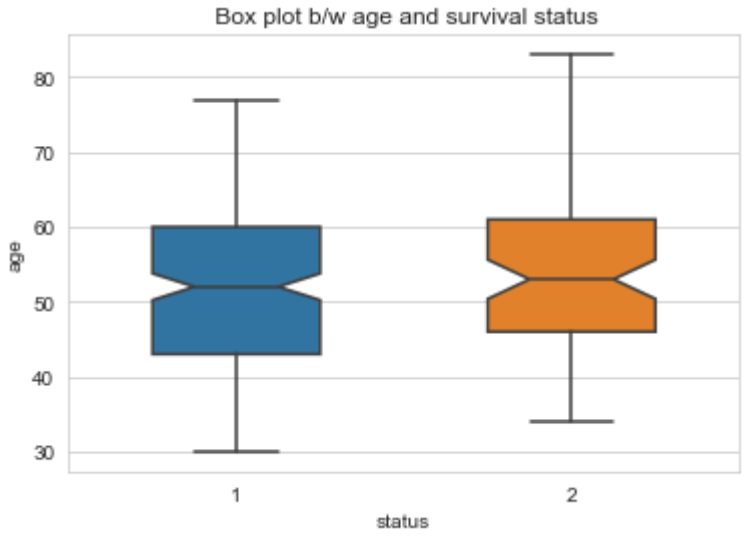
Drawing more insights through median, quartile through box plot

In [72]:

```
sns.boxplot(data=haberman_data,x='status',y='age',width=0.5,notch=True).set_title(" Bo
#median age for stage 1 people is- 52
print (np.median(haberman_data_longsurvive['age']))
print (np.percentile(haberman_data_longsurvive['age'],25))
print (np.percentile(haberman_data_shortsurvive['age'],25))


```

```
52.0
43.0
46.0
```



Insights from Box Plot:

Median age for stage 1 people is: 52 Percentile of stage 1 patients are less than 43 years Percentile of stage 2 patients are less than 46years

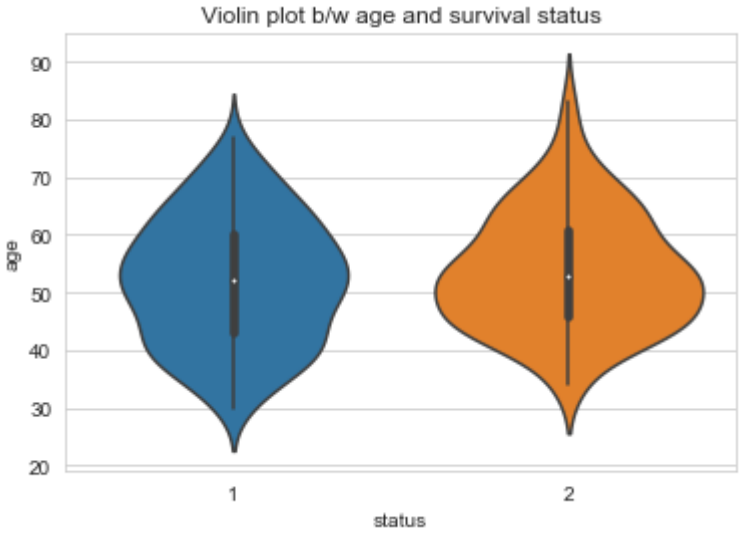
Plotting Violin plot

In [74]:

```
1 sns.violinplot(data=haberman_data,x='status',y='age').set_title("Violin plot b/w age a
```

Out[74]:

```
Text(0.5, 1.0, 'Violin plot b/w age and survival status')
```



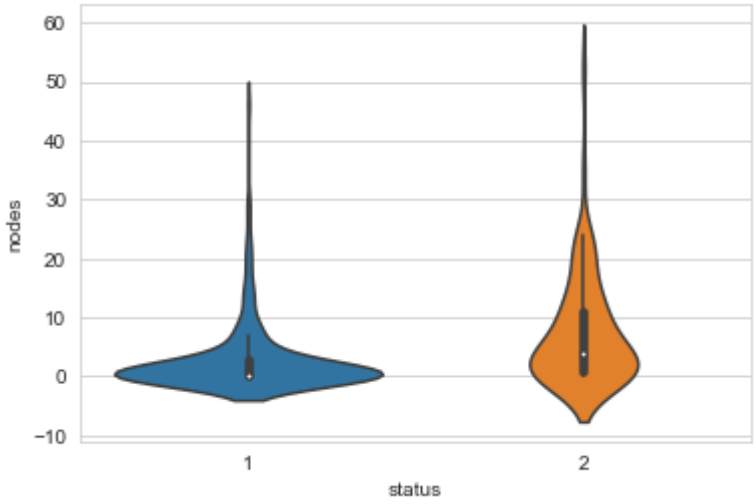
In [34]:

```
sns.violinplot(data=haberman_data,x='status',y='nodes')

```

Out[34]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x2088a897860>
```



Insights from Violin plot:

stage 1 patients has lesser affected lymph (less than 10)

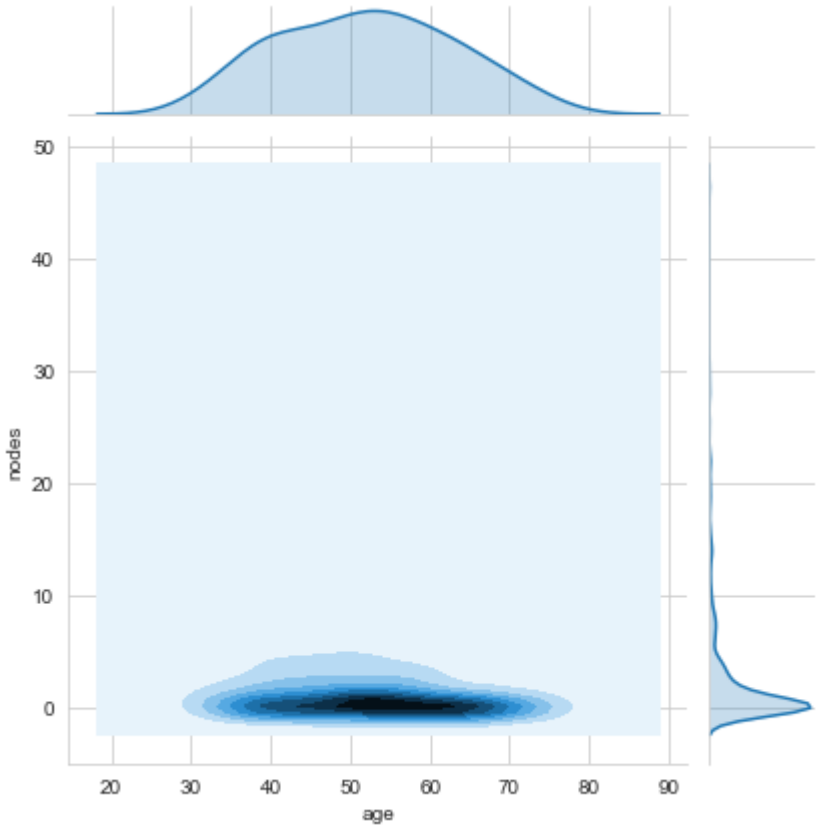
Plotting Join plot to see the distribution across age of Patient and Affected Nodes

In [79]:

```
1 sns.jointplot(data=haberman_data_longsurvive,x='age',y='nodes',kind='kde')
```

Out[79]:

```
<seaborn.axisgrid.JointGrid at 0x2088c6a4b00>
```



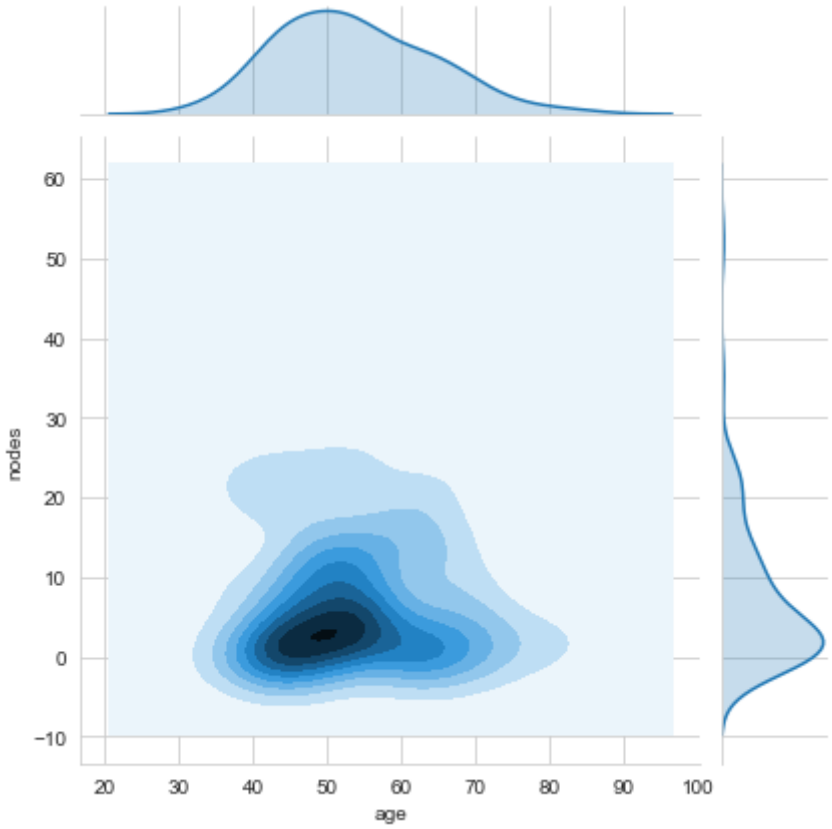
In [36]:

```
sns.jointplot(data=haberman_data_shortsurvive,x='age',y='nodes',kind='kde')

```

Out[36]:

```
<seaborn.axisgrid.JointGrid at 0x2088a88f8d0>
```



Insights from JOINT plot:

for stage 1 patients, denisty can be seen higher for age between (40-60)years for stage 2 patients, denisty can be seen higher for age between (45years-65years)

Analysis with all observations :

In our dataset, We have 4 columns.

Age- Age of the patient.

Year-In which year patient went through the surgery.

Lymph Nodes- How many affected lypmh nodes does the person had before the surgery

Survival Status:

It represent whether patient survive more than 5 years or less after undergone through surgery. Here if patients survived 5 years or more is represented as 1 patients who survived less than 5 years is represented as 2.

Period of Survey

The survey started in 1958 and completed in 1969 with experimenting total of 306 patients. The survey had below key points: out of 306 patients, 225 patients survived for more than 5 years out of 306 patients, 81 patients survided for less than 5 years

patient with age 54 has maximum cancer patient encountered patient with age 83(eldest) has minimun patient encountered

1958 was the year in which we had most no of surgeries/patient encountered-36 surgery 1969 was the year in which we had least no of surgeries/patient encountered-11 surgery

Patient of age group (30-40) and (72-77) have survival status as 1: meaning they have survived for more than 5 years

Patient with status 1 had lesser no. of affected lymph nodes

Conclusion:

Status 1

if the affected lymph nodes is less than 10, probability is 80% patient will be status 1 if the affected lymph nodes more than 35, probability is 95% patient will be stage 1

Status 2

if the affected lymph nodes is less than 10, probability is 65% patient will be status 2 if the affected lymph nodes is more than 35 probability is 95% patient will be status 2 Most number of patients with staus 1 are from age 55-60 with survival rate of 44% Least number of patients with status 1 are from age group 75-80 with survival rate of 100% Status 1: Success rate of surgery of 100% has been observed as patient with age > 70 years

Success rate of surgery of 7.5% has been observed as patient with age <45 years

Most number of patients with status 2 are from age 48-55 with survival rate of 40% Least number of patients with status 2 are from age 75-85 with survival rate of 100% Status 2: Success rate of surgery with 100% has been observed as pateint with age > 75 years

Success rate of surgery with 7.5% has been observed for patient with age <45 years

In [80]:

```
1 ### Function developed to guess the survival status of a new patient
```

In [81]:

```
def status(age,nodes):
    if ((70<=age<=85) and ((35<=nodes<=50) or (nodes<11))):
        return True
    elif ((45<=age<=69) and (35<=nodes<=50)):
        return False
age=int(input('Enter the patient\'s age :  '))
nodes=int(input('Enter the count of lymph nodes :  '))
result=status(age,nodes)
if result:
    print ('surgery status is 1')
else:
    print ('surgery status is 2')
```

```
Enter the patient's age :  34
Enter the count of lymph nodes :  10
surgery status is 2
```